LIBRARY
OF THE
CHIEF CONSERVATOR OF FORESTS MADRAS.
MADRAS
W. P.

PROCEEDINGS OF THE CHIEF CONSERVATOR OF FORESTS
No. 293, PRESS, DATED 17TH AUGUST 1928

REVISED WORKING PLAN

FOR THE

NILAMBUR VALLEY

PREPARED BY

R. S. BROWNE, Esq.,
Deputy Conservator of Forests.

1928-29 TO 1937-38

MADRAS
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS
1929

B.2117 N
M29
95506

PROCEEDINGS OF THE CHIEF CONSERVATOR OF FORESTS

No. 293, PRESS, DATED 17TH AUGUST 1928

REVISED WORKING PLAN

FOR THE

NILAMBUR VALLEY

PREPARED BY

R. S. BROWNE, ESQ.,

Deputy Conservator of Forests.

1928-29 TO 1937-38

INTRODUCTION.

Schemes for regulating the fellings in the Nilambur teak plantations were prepared by Colonel Campbell Walker, in 1885 and 1890. Mr. P. M. Lushington's working plan of 1895 superseded these schemes. This working plan prescribed the treatment of all the forests covered by the present working plan, with the exception of the New Amarampalam Reserve. In 1905 Mr. Lushington revised his prescriptions for the plantation areas. This revised working plan was in force from 1905 to 1915. In the latter year Mr. R. Bourne commenced the preparation of a new working plan, for all the forests of the division. Many of his prescriptions were brought into force from the year 1918, though the working plan was not completed till 1921. Mr Bourne's working plan was not sanctioned for reasons explained hereafter, but effect has been given to many of his proposals.

On 24th November 1925, the author of the present working plan was posted as a Working Plans Officer, with instructions to revise Mr. Bourne's plan. The management of the forests, and particularly of the teak plantations, was in a most unsatisfactory state, owing to a number of causes, most of them abnormal. Having had no previous experience of the Nilambur division, he was obliged to spend a number of months in preliminary inspections before he was in a position to formulate proposals for future working. A preliminary report was submitted on the 2nd April 1926 and orders on it were passed by the Chief Conservator on the 25th May 1926. Thus it was impossible to make a real start on the field work until the monsoon lightened, in August 1926. Field work was in progress from August 1926 till March 1928, and was only interrupted for short periods during which the writer had to go to Ootacamund in connexion with the preparation of maps, and other office work. Most of the working plan was written while field work was in progress, and it was completed on the 5th April 1928. Mr. Bourne's general policy has been largely followed, but the plan, though called a revision, really amounts to a new working plan. Its length may be explained by pointing out (*a*) that the Working Plans Officer was ordered to incorporate Mr. Bourne's Part I, with such additions and corrections as were necessary, and (*b*) that past experience showed that considerable detail in the prescriptions of Part II was desirable.

The Working Plans Officer was assisted, in the field work, by the following rangers :—

Ranger K. Chaikku from 23rd January 1926 to 30th September 1926.

Ranger K. Kunhiraman Menon from 30th April 1926 to 5th April 1928.

Ranger M. N. Raman Pillai from 16th November 1926 to 20th September 1927.

Most of the statistics relating to past yields, past revenue and expenditure, prices, etc., were compiled by the Working Plans Clerk, M. P. Narayana Menon, assisted by the clerks of the Nilambur District Forest Office. A partial check has been made by the Working Plans Officer.

The maps have been prepared by M.R.Ry. C. R. Samarapuri Mudaliyar, Draftsman of the III (Working Plans) Circle.

The Working Plans Officer would like to take this opportunity of thanking the officers and subordinates, of offices other than the Working Plans Circle, who have assisted him, particularly the staff of the Nilambur district, and of the Logging Engineering Branch.

OOTACAMUND,
The 5*th April* 1928.

R. S. BROWNE,
Working Plans Officer, Nilambur.

TABLE OF CONTENTS.

PART I.

Summary of facts on which the proposals are based.
CHAPTER I.—THE TRACT DEALT WITH.

SECTION 1.—NAME AND SITUATION.

Paragraph		PAGE
1.	General	1
2.	Position	1
3.	Distribution	1

SECTION 2.—CONFIGURATION OF THE GROUND.

A.—Plains.

4.	General	1
5.	Elevation	1
6.	Rivers and streams	1
7.	River alluvium	1
8.	Degree of drainage	1
9.	Effect of bad drainage	2
10.	Summary	2

B.—Ghats.

11.	General	2
12.	Elevation	2
13.	Aspect	2

SECTION 3.—GEOLOGY, ROCK AND SOIL.

14.	General	2
15.	Gneiss	2
16.	Laterite	2
17.	Quartz	2
18.	Soils	2
19.	Alluvial deposits	2
20.	Clay	3
21.	Humus	3
22.	Depth and drainage	3
23.	Apparent deterioration of the soil under pure teak	3
24.	Summary	4
25.	Faulty selection of sites for teak in the past	4

SECTION 4.—CLIMATE.

26.	General	5
27.	Temperature	5
28.	South-west monsoon	5
29.	North-east monsoon	5
30.	Dry weather	5
31.	Rainfall	5
32.	Winds	7
33.	Storms	7
34.	Summary	7

SECTION 5.—WATER-SUPPLY.

35.	Water-supply	7

SECTION 6.—DISTRIBUTION AND AREA.

36.	Division into ranges	7
37.	Nilambur range	7
38.	Amarampalam range	8
39.	Survey and maps	8
40.	Area figures adopted	8
41.	Abridged table of areas	8

SECTION 7.—STATE OF THE BOUNDARIES.

42.	Natural boundaries	9
43.	Artificial boundaries	9
44.	Importance of final demarcation	10
45.	Register of boundaries	10

SECTION 8.—LEGAL POSITION.

46.	General	10

A.—Leased Forests.

Paragraph		PAGE
47.	From Trikkalayur devaswam ...	10
48.	From Nilambur Tirumalpad ...	12
49.	From Zamorin Raja of Calicut ...	14
50.	From Wandur Nambudripad ...	14
51.	Summary ...	15
	B.—Forests in the absolute possession of the State.	
52.	Purchased from Edavanna kovilagam ...	15
53.	Also purchased from Edavanna kovilagam ...	15
54.	Closing of all forests in the division to grazing ...	16
	SECTION 9.—RIGHTS AND CONCESSIONS.	
55.	Rights ...	16
56.	Concessions ...	16

CHAPTER II.—THE FOREST.

	SECTION 1.—COMPOSITION AND CONDITION OF CROP.	
57.	Types of forest ...	16
	A.—Evergreen Forests on the Ghats.	
58.	General ...	17
59.	Above 6,000 feet ...	17
60.	5,000 to 6,000 feet ...	17
61.	4,000 to 5,000 feet ...	17
62.	Below 4,000 feet ...	17
63.	Their beauty ...	17
	B.—Semi-deciduous forests of the Foot-hills.	
64.	General ...	17
65.	Pure bamboo forest ...	17
66.	Timber high forest ...	17
67.	Predominant factors of locality affecting growth and distribution of species ...	18
	C.—Semi-deciduous forests of the Plains.	
68.	General ...	18
	(i) *Areas planted with teak.*	
69.	General ...	19
70.	Appearance of other species naturally ...	19
71.	Appearance of these species in pure teak woods attracts attention and affords an excellent opportunity for studying their silvicultural requirements ...	20
72.	Quality of teak growth and the predominant factors of locality affecting the same ...	20
73.	Second rotation crops ...	22
74.	Underwoods and undergrowth—General description ...	23
75.	Reasons for the unsatisfactory condition of the underwood ...	23
76.	Species occurring in the underwood and undergrowth ...	24
77.	Underwoods, distinguishable from undergrowth ...	24
78.	Underwoods introduced artificially ...	25
	(ii) *Natural Forests.*	
79.	General ...	26
80.	Distribution of bamboo ...	26
81.	Effect of bamboo upon the distribution both of types of forest and of species ...	26
82.	Five-storeyed high forest ...	26
83.	Four-storeyed high forest ...	27
84.	Three-storeyed high forest ...	27
85.	Two-storeyed high forest ...	27
86.	Swampy timber forest ...	28
87.	Grass swamps ...	28
88.	Types of forest found here and there along river banks ...	28
	SECTION 2.—INJURIES TO WHICH THE CROP IS LIABLE.	
89.	Wind ...	28
90.	Drought ...	29
91.	Lightning ...	30
92.	Floods and excessive rain ...	30
93.	Fire ...	30
94.	Grass and weeds ...	31
95.	Climbers ...	31
96.	Parasites ...	32
97.	Insects ...	32
98.	Animals ...	34
99.	Man ...	35

Paragraph PAGE

CHAPTER III.—UTILIZATION OF THE PRODUCE.

SECTION 1.—AGRICULTURAL CUSTOMS AND WANTS OF THE POPULATION.

100. The local population ... 36
101. Wants of the population ... 36

SECTION 2.—MARKETS AND MARKETABLE PRODUCTS.

102. Markets ... 36
103. Sale depots and saw mills ... 36
104. Method of marketing ... 37
105. Local sales ... 37
106. Marketable products ... 37
107. Statement of classification of timber and poles ... 39

SECTION 3.—LINES OF EXPORT.

108. Lines of export ... 39

SECTION 4.—METHODS OF EXPLOITATION.

109. Agency of exploitation ... 40
110. Marking for felling ... 40
111. Felling and preliminary classification ... 40
112. Check-measurement and final classification ... 41
113. Dragging and carting to river-side depots ... 41
114. Dragging ... 42
115. Tying into rafts ... 42
116. Floating ... 43
117. Stacking in sale depot ... 43
118. Timber registers and forms ... 43

SECTION 5.—COST OF EXPLOITATION.

119. General review ... 45
120. Total cost of production ... 46
121. Current or recent exploitation rates ... 46
122. Exploitation rates in 1918 ... 48

SECTION 6.—PAST AND CURRENT PRICES.

123. General ... 52
124. Prices of plantation teak ... 52
125. Prices of timber and bamboos from natural forests ... 54
126. Minor forest produce ... 56

CHAPTER IV.—STAFF AND LABOUR SUPPLY.

SECTION 1.—THE FOREST STAFF.

127. Present strength ... 56
128. District Forest office ... 57
129. Nilambur and Amarampalam ranges ... 57
130. Quality of the subordinates ... 57

SECTION 2.—LABOUR SUPPLY.

131. General description of the labour position ... 57
132. Nilambur range ... 58
133. Amarampalam range ... 58
134. Wages ... 58

CHAPTER V.—PAST SYSTEMS OF MANAGEMENT.

SECTION 1.—GENERAL HISTORY OF THE FOREST.

135. Sources of information ... 59
136. Reason why all the forests are leased or have had to be purchased ... 59
137. How some forests came to be leased by Government ... 59
138. First attempts to sow and transplant teak ... 60
139. Planting out nursery seedlings eventually resorted to ... 61
140. Tribute to Mr. H. V. Conolly ... 61

A.—Period 1844—1862.

141. General ... 61
142. Establishment maintained—Labour available ... 61
143. Fellings and other works undertaken ... 62
144. Great credit due to Mr. Chatu Menon ... 62

PAGE

Paragraph

B.—Period 1862—1883.

145. General 62
146. Establishment and labour 63
147. Acquisition of further forests 63
148. Extension of the plantations 64
149. The introduction of exotics results from the stopping of planting 64
150. Fellings and other works undertaken 64

C.—Period 1883—1895.

151. General 65
152. Acquisition of further forests 65
153. Extension of the plantations 65
154. Fellings and other works undertaken 66
155. Proposals for the preparation of a regular working plan 66

D.—Period of Mr. Lushington's first working plan, 1896—1905.

156. General 66
157. Modifications of the plan proposed by Mr. Ribbentrop, Inspector-General of Forests 67
158. The execution of Mr. Lushington's and Mr. Grenfell's supplemental plan ... 67

E.—Period of Mr. Lushington's second working plan, 1906—1915.

159. General 67
160. Modifications of the plan suggested by Mr. Eardley Wilmot, Inspector-General of Forests 68
161. The execution of this plan 68

F.—The period of the preparation of Mr. Bourne's working plan, 1915—1918.

162. General 69

G.—Period of Mr. Bourne's working plan, 1918—1928.

163. General 69
164. The Malabar rebellion of 1921-22 70
165. Changes of officers 71
166. The floods of 1924 72
167. Teak regeneration with field crops 72

SECTION 2.—PAST SYSTEMS OF MANAGEMENT AND THEIR RESULTS, 1843—1918.

168. General 72

A.—Plantations.

169. Methods of formation adopted 72
170. Preliminary tending for the proper establishment of the crop 77
171. Cost of formation and preliminary tending 79
172. Subsequent tending 79
173. Experimental formation of woods of indigenous species other than teak ... 85
174. Experimental introduction of underwoods in the teak areas 86
175. Experimental planting with exotics 86

B.—Natural Forests.

176 General 87
177. Timber fellings 87
178. Bamboo fellings 87

SECTION 3.—PAST SYSTEMS OF MANAGEMENT AND THEIR RESULTS, 1918—1928.

179. General 88
180. Plantation Working Circle 88
181. Conversion Working Circle 90
182. Experiments 91
183. Control records 97
184. Costs of regeneration 97
185. Protection 98
186. Elephant capturing 98

SECTION 4.—SPECIAL WORKS OF IMPROVEMENT UNDERTAKEN.

187. General 98
188. Forest roads and bridle-paths 98
189. Telephone line 99
190. Buildings 99
191. Wells 100
192. Shoranur-Nilambur Railway 100
193. Saw-mills 100

Paragraph PAGE

SECTION 5.—PAST YIELD.

194. Yield from natural forests ... 100
195. Summary of annual outturn from natural forests ... 100
196. Yield from teak plantations ... 103
197. Summary of annual outturn from plantations ... 103

SECTION 6.—PAST REVENUE AND EXPENDITURE.

198. General ... 106
199. Summary of past revenue ... 106
200. Summary of past expenditure ... 108
201. Capital account ... 110

CHAPTER VI.—STATISTICS OF GROWTH AND YIELD.

SECTION 1.—STATISTICS RELATING TO TEAK.

202. Mr. Bourne's yield tables ... 112
203. Statistics from periodical measurements of sample plots ... 112

SECTION 2.—STATISTICS RELATING TO SPECIES OTHER THAN TEAK.

204. Timber species ... 112
205. Bamboos ... 113

CHAPTER VII.—ESTIMATE OF COST VALUE OF THE LAND.

206. General ... 114
207. Statements of kuttikanam and lease payments ... 114
208. Determination of the cost value ... 124

PART II.

Future Management discussed and prescribed.

CHAPTER I.—BASIS OF PROPOSALS.

209. Factors which indicate the future policy ... 126
210. General objects of management ... 126
211. Means of attaining the objects of management ... 126
212. Methods of treatment to be adopted ... 127
213. Working circles, their area and distribution, reasons for their constitution ... 127
214. Period of working plan and necessity for intermediate revision ... 128

CHAPTER II.—WORKING PLAN FOR THE PLANTATION WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTER OF THE VEGETATION.

215. Area ... 128
216. General constitution ... 128
217. General character of the vegetation ... 128

SECTION 2.—PERMANENT DIVISION OF THE AREA.

218. Blocks ... 128
219. Plantations ... 128
220. Compartments ... 128

SECTION 3.—TEMPORARY DIVISION.

221. Sub-compartments ... 129
222. Felling series ... 129

SECTION 4.—ANALYSIS AND VALUATION OF THE CROP.

223. Stock-mapping ... 129
224. Description of compartments and valuation of the growing stock ... 130
225. Summary of Quality and Age Class Table ... 130

SECTION 5.—TEAK FELLING SERIES—METHOD OF TREATMENT.

226. Choice of species ... 130
227. Silvicultural system ... 131
228. Rotation ... 131
229. Regulation of the yield ... 131

Presrciptions.

230. Marking for final felling ... 131
231. Marking of compartment boundaries ... 131
232. Final felling ... 131
233. Clearing the area ... 132
234. Collection of seed ... 132
235. Nurseries ... 133
236. Aligning and staking ... 133

Paragraph PAGE

Prescriptions—cont.

237. Loosening soil at stakes ... 133
238. Formation ... 134
239. Weeding in year of formation ... 135
240. Artificial introduction of a ground cover crop ... 136
241. Pruning ... 137
242. Second-year weeding ... 137
243. Exclusion of cattle ... 138
244. Thinning ... 138
245. Climber cutting, loranthus clearing, bamboo cutting and harvesting dead trees ... 140
246. Underwoods ... 140
247. Reclamation of second rotation failed areas in good teak localities ... 141
248. Tabular statements of operations ... 142
249. Plan of final felling ... 143
250. Plan of formation ... 145
251. Plan of thinning ... 146
252. Plan of subsidiary tending... 149
253. Plan of formation and tending of underwoods ... 149
254. Plan of reclamation of failed areas for teak ... 150

SECTION 6.—MISCELLANEOUS FELLING SERIES—METHOD OF TREATMENT.

255. Choice of species ... 151
256. Silvicultural system ... 151
257. Rotation ... 151
258. Regulation of the yield ... 151

Prescriptions.

259. Fellings ... 151
260. Artificial regeneration ... 152
261. Thinning and cleaning ... 153
262. Tabular statements of operations ... 153
263. Plan of final felling ... 154
264. Plan of artificial regeneration ... 155
265. Plan of thinning and cleaning ... 157

SECTION 7.—PRESCRIPTIONS COMMON TO BOTH FELLING SERIES.

266. Fire protection ... 157
267. Protection against animals... 157
268. Protection against insects ... 158
269. Cost of regeneration ... 158
270. Choice of tools ... 158
271. Maintenance of compartment boards ... 159

SECTION 8.—CONTROL.

272. General ... 159
273. Control book ... 159
274. Record of works ... 159
275. Compartment history ... 159
276. Maps ... 159

CHAPTER III.—WORKING PLAN FOR THE CONVERSION WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTER OF THE VEGETATION.

277. Area ... 159
278. General constitution ... 159
279. General character of the vegetation ... 160

SECTION 2.—PERMANENT DIVISION OF THE AREA.

280. Blocks ... 160
281. Compartments ... 160

SECTION 3.—ANALYSIS AND VALUATIONS OF THE CROP.

282. Stock-mapping ... 160
283. Description of compartments ... 160
284. Valuations of the growing stock ... 160

SECTION 4.—ALLOTMENT TO PERIODIC BLOCKS.

285. Area available for conversion ... 161
286. Conversion rotation... 161
287. Division into periods ... 161
288. Allotment to periodic blocks ... 161

PAGE

Paragraph

SECTION 5.—PERIODIC BLOCK I.—METHOD OF TREATMENT.

289. Choice of species ... 163
290. Silvicultural systems ... 163
291. Selection of areas for regeneration... 163
292. Regulation of the yield ... 164

Prescriptions.

293. Marking and felling ... 164
294. Formation of teak plantations ... 164
295. Second-year tending of teak plantations ... 165
296. Introduction of Hopea on hill-tops ... 166
297. Formation of crops of miscellaneous species ... 166
298. Tending subsequent to the establishment of the crops ... 167
299. Thinning ... 167

SECTION 6—CONVERSION WORKING CIRCLE EXCLUSIVE OF PERIODIC BLOCK I.

300. General ... 167
301. Period of working ... 168
302. Division into annual coupes ... 168
303. Subsidiary fellings ... 168
304. Climber cutting after subsidiary fellings ... 169
305. Conversion by means of improvement fellings ... 169
306. Xylia sleeper fellings ... 169
307. Regulation of the yield ... 169

SECTION 7.—PRESCRIPTIONS COMMON TO THE WHOLE WORKING CIRCLE.

308. Formation and maintenance of compartments ... 169
309. Fire protection ... 170

SECTION 8.—TABULAR STATEMENTS OF OPERATIONS.

310. General ... 170

Periodic Block I.

311. Plan of final felling ... 170
312. Plan of formation ... 171
313. Plan of thinning ... 172

Conversion Working Circle exclusive of Periodic Block I.

314. Plan of subsidiary felling, improvement felling and climber cutting ... 173
315. Plan of Xylia sleeper fellings ... 173

SECTION 9—CONTROL.

316. General ... 174
317. Control book ... 174
318. Record of works ... 174
319. History and description of compartments ... 174
320. Maps ... 174

CHAPTER IV.—WORKING PLAN FOR THE INACCESSIBLE WORKING CIRCLE.

321. Area, situation and brief description ... 174
322. Valuation of the growing stock ... 174
323. Prescriptions ... 174

CHAPTER V.—WORKING PLAN FOR THE BAMBOO WORKING CIRCLE.

324. Area ... 175
325. Departmental working ... 175
326. Removal by purchasers ... 175
327. Control ... 175

CHAPTER VI.—WORKING PLAN FOR THE MINOR PRODUCE WORKING CIRCLE.

328. Constitution of the Working Circle ... 175
329. General lease of minor produce ... 175
330. Lease of canes ... 175
331. Control ... 175

CHAPTER VII.—MISCELLANEOUS REGULATIONS (PRESCRIBED AND SUGGESTED).

SECTION 1.—ROADS AND OTHER EXPORT WORKS.

332. Bridges ... 176
333. Roads ... 176
334. Rafting facilities ... 176

Paragraph PAGE

SECTION 2.—IMPROVEMENT OF METHODS OF EXPLOITATION.

335. Exploitable species ... 176
336. Felling ... 177
337. Logging ... 177
338. Extraction ... 177
339. Costs of exploitation ... 177
340. Timber forms ... 177

SECTION 3.—UTILIZATION OF THE PRODUCE.

341. Marketing ... 177
342. Sale depots ... 178
343. Grading of timber ... 178
344. Possible development of forest industries ... 178

SECTION 4.—PROTECTION OF TIMBER.

345. Inspections ... 178
346. Timber transit rules ... 178

SECTION 5.—BUILDINGS, WELLS, ETC.

347. New buildings ... 178
348. Repairs to existing buildings ... 179
349. Improvements in existing buildings ... 179
350. Coolie lines ... 179
351. Temporary sheds ... 179
352. Wells ... 179
353. Rain gauge ... 179

SECTION 6.—MAINTENANCE OF BOUNDARIES.

354. Permanent demarcation ... 179
355. Register of boundaries ... 180

SECTION 7.—LIVESTOCK.

356. Working elephants ... 180
357. Elephant capturing... 180
358. Buffaloes ... 180
359. Bullocks ... 180
360. Cost of feed and keep ... 180

SECTION 8.—STORES, TOOLS AND PLANT.

361. Ordinary expenditure on stores and tools ... 180
362. Extraordinary expenditure ... 180

SECTION 9.—CONTROL.

363. General ... 181
364. Control Book ... 181
365. Record of Works ... 181
366. Compartment History ... 181
367. Control Journal ... 181
368. Regeneration Ledger ... 181
369. Register of Deviations ... 181
370. Maps ... 181

CHAPTER VIII.—ESTABLISHMENT AND LABOUR.

SECTION 1.—ESTABLISHMENT.

371. Executive staff ... 182
372. Distribution of the executive staff... 182
373. Clerical staff ... 182

SECTION 2.—LABOUR.

374. General ... 182
375. Nilambur Range ... 182
376. Amarampalam Range ... 182

CHAPTER IX.—FINANCIAL FORECAST AND COST OF THE WORKING PLAN.

377. Financial forecast ... 183
378. Cost of the working plan ... 185

SUMMARY OF PRESCRIPTIONS. ... 185
APPENDICES ... 193

PART I.

SUMMARY OF FACTS ON WHICH THE PROPOSALS ARE BASED.

CHAPTER I.—THE TRACT DEALT WITH.

SECTION 1.—NAME AND SITUATION.

1. *General.*—The working plan covers all the forests in the Nilambur and Amarampalam Ranges of the Nilambur Forest Division, with the exception of the Beypore Reserve. The forests include the well-known Nilambur teak plantations. They are all in the possession of the State, partly by purchase and partly on what may be considered perpetual leases.

2. *Position.*—They are situated within 11° 10′ and 30′ North Latitude and 75 55′ and 76° 35′ Longitude East of Greenwich. They all lie within the water-shed of the Chaliarpuzha and its tributaries. This river is more generally known as the Nilambur or the Beypore river.

3. *Distribution.*—There is one large compact area of forest, consisting of the New Amarampalam, Karumpoya and Nellicutta reserves, which covers the greater part of the outer slopes of the Kundah Range, the western escarpment of the Nilgiri plateau, and a stretch of plains at their foot. The remaining forests are scattered along the banks of the Karumpuzha and its tributaries. The individual reserves and leased forests comprising them vary in extent from 1 to 2,800 acres. Around Nilambur alone are any of them contiguous, forming continuous areas of any size.

SECTION 2.—CONFIGURATION OF THE GROUND.

A. PLAINS.

4. *General.*—The primary topographical feature of the locality is the sharp division of the area into plains and ghats. The plains of South Malabar, except for a belt of practically level ground of varying width along the sea-board, are characteristically undulating.

5. *Elevation.*—The higher ground rises for the most part less than 300 feet above mean sea level, and exceptionally to as much as 1,500 feet.

6. *Rivers and streams.*—The whole area is traversed by a net work of rivers and streams, the former of which run, generally, between high banks, some 10 feet —50 feet above the level of the river bed. The main river, the Chaliarpuzha, traversing the locality in which the forests, covered by this working plan, are situated, runs more or less due east to west. It has three main head water streams—the Chaliarpuzha, the Karumpuzha and the Punnapuzha. The first rises in the south-west of the Wynaad plateau, while the latter two rise in the Kundah Range. The two latter join within 2 miles of their confluence with the first, some 3 miles above Nilambur. The fall of these rivers, even right up to the foot of the ghats, is slight. The elevation of the river-bed at Chaliarmukku, at the confluence of the Chaliarpuzha with the Karumpuzha and Punnapuzha, is only 70 feet above mean sea level. This point is 32 miles, as the crow flies from the mouth of the river. Again, the elevation of the river-bed of the Karumpuzha and Punnapuzha, at the foot of the ghats, is about 225 feet only. Above these points they are torrents.

7. *River alluvium.*—Bordering these rivers and smaller streams there are strips of practically level ground, varying in width from a few yards to several miles. In the latter case, however, there are always hillocks dotted about, of varying size. The strips of continuous level ground are rarely wider than half a mile.

8. *Degree of drainage.*—The degree of surface drainage over the whole or part of such strips is often very slight. Also the drainage of the lower layers of the soil may vary to a considerable degree. Close to the river it may be very good, further away

it may be very bad. The importance of this lies in the fact that, with bad drainage of the soil, sub-soil and surface, combined with the heavy rainfall of the monsoon, swampy conditions may prevail. The smaller streams also often have such a slight fall that, with the heavy rainfall, they are unable to carry off the water with sufficient rapidity, resulting in similar swampy conditions over considerable areas and for an appreciable period of time.

9. *Effect of bad drainage—(a) On the soil.*—Such conditions, if prolonged for a sufficient length of time, must seriously affect the aeration of the soil, not only during the period of inundation, when all the air and consequently the greater part of the free oxygen is expelled from the soil and replaced by water, but also subsequent to evaporation, owing to the deposit of fine silt upon the surface of the soil, which, on evaporation of the water, forms a hard caked surface effectually hindering the free passage of air; *(b) on distribution of plant growth.*—Consequently, the result of such conditions is that only plants which have their root systems adapted or are able to adapt themselves to such environments, grow in such areas. In the remote and uninhabited regions, these areas form more or less open grass swamps, with only such tree species as exist under swampy conditions. In the more populated localities, such areas have been brought under paddy cultivation, the paddy plant being one of the few cultivated plants which thrive in marshy soils.

10. *Summary.*—The configuration of the ground in the plains has, therefore, a very far-reaching effect upon the distribution of forests and species in this locality and particularly in the plains' areas covered by this working plan, since they are mostly situated along the river banks.

B. Ghats.

11. *General.*—The ghats, on the other hand, are characteristically precipitous. Even the lower slopes are steep, becoming, with increasing elevation, more and more precipitous.

12. *Elevation.*—The ghat forests covered by the working plan vary in elevation between 250 feet and 8,200 feet above mean sea level, the area above 6,000 feet being almost sheer precipice.

13. *Aspect.*—The summit of the Kundah Range forms a crescent, the points of which face to the west. The general aspect is, therefore, western. The many spurs, descending from the ridge, either converge towards the main valley of the Karumpuzha running from north-east to south-west or south-east to north-west, or run from south-east to north-west towards the valley of the Punnapuzha.

Section 3.—Geology, rock and soil.

14. *General.*—The underlying rock is Archæan.

15. *Gneiss.*—On the ghats and to some extent on the plains, the rock is gneiss of a granitic nature. On the foothills and over the greater part of the plains the gneiss is foliated to a much greater degree. It is probably part of a lower stratum than that found on the surface of the ghats.

16. *Laterite.*—The foliated gneiss is formed into laterite probably by the action of micro-organisms. The distribution of the laterite is so extensive that all trace of the underlying gneiss is often lost over large areas.

17. *Quartz.*—Throughout the area intrusive veins of quartz are to be seen. In the laterite areas particularly, the quartz veins having broken down, quartz boulders and rocks of all sizes are found scattered over the surface.

18. *Soils.*—By disintegration the granitic gneiss forms a very fine loam of varying depth. This varies mainly according to the position and slope, shallow and stony on the ridges, deep and fine in the valleys. The laterite is found in varying degrees of disintegration, from a hard rock to a fine gravel.

19. *Alluvial deposits.*—The gneiss or the laterite is, along the rivers and streams, overlaid by river alluvium generally to a great depth, as much as 70 feet in many places. This alluvium is a fine sandy loam, rich in organic matter and minute particles of mica. It generally contains a large number of water-worn pebbles and boulders of quartz and gneiss. The river alluvium is overlaid near hillocks in the plains by laterite alluvium.

20. *Clay.*—In low-lying localities liable to inundation, the soils are overlaid with a very fine clayey silt, which may, in part, be washed down into the air spaces in the upper surface of the soil. From the nature of the soils this action takes place to a greater degree in the case of laterite alluvium than in the others. This clay deposit is probably never very deep and is in most cases a matter of only a few inches.

21. *Humus.*—Humus varies in depth throughout the forest areas, from a fairly deep layer in some of the virgin forests to a comparatively shallow layer in some of the areas under pure teak. In some of the latter, it is even indistinguishable. The depth, of course, also depends upon the configuration of the ground.

22. "*Depth and drainage.*—It is particularly to be noted that the drainage of the sub-soil, soil and the surface, combined with depth, are the primary factors affecting growth. Poor drainage means bad soil-aeration in a locality with such heavy rainfall. Given good drainage and good depth, localities with river alluvium or loam (the result of the disintegration of gneiss) produce by far the finest tree growth. Further, there is little to choose between them. In the case of teak, there are data to prove this. In the case of virgin forests and the majority of species occurring in them, casual inspection of such localities is sufficient to convince. Literally, within a few yards, a forest of magnificent growth may give place to one of comparatively poor or even very poor growth. If the change is due to a difference in drainage and if it is a mixed forest of many species, many of the species occurring in the well drained area may disappear in the badly drained area, often giving place to others. With the exception of laterite alluvium, laterite soils are not very permeable to water. This, of course, depends upon the degree of disintegration. Water generally runs off the surface of laterite soil very fast provided that there is a sufficient slope. Quite coarse gravel is washed away. Surface disintegration is very rapid. The soil in consequence is never of any great depth. For these reasons the growth in such localities is much inferior to that on well-drained deep alluvium or loam. Further, species demanding a deep friable soil may even not occur in such areas. As to low-lying localities, where there is a mixture of clay in the surface soil or on the surface, only such species thrive as have roots adapted or other special means for absorbing oxygen when growing in badly aerated soils." [R. Bourne.]

23. *Apparent deterioration of the soil under pure teak.*—In 1917, final fellings were commenced in the old plantations, and since then an average coupe of 80 acres has been felled and cleared annually, and replanted with teak. Admittedly it is early to judge these second rotation crops (of which the oldest is scarcely 11 years) but there is every indication that they are generally inferior to their predecessors on the same sites, and to plantations of the same age on natural forest clearings in apparently similar localities. Further, there are instances in which areas, replanted with complete success, and carefully weeded, have already virtually failed. Such instances are more common on laterite than on alluvial soils, but they do occur, even on alluvium, in localities where failure cannot be attributed to swamp. It is generally recognized that a pure crop of a deciduous species (especially in the tropics) is incapable of preserving the fertility of the soil. In the better plantations at Nilambur not only is teak the sole species in the upper canopy, but there is also a serious deficiency in soil—protecting species of trees and shrubs in the under storey, largely owing to the regular clearing of undergrowth from 1863 to 1906. The scientific investigation of the question is hampered by the difficulty in finding natural forest soil which is comparable, for purposes of analysis, with the soil of the old plantations. Practically all the deep alluvium has been planted up long ago, and an ocular examination of disintegrated laterite soils in the plantations makes it perfectly obvious that surface wash has made such soils quite dissimilar to those found in similar localities under virgin forest. The writer has been able to obtain a few samples of plantation soil, for purposes of comparison, with soil taken from adjacent virgin forest, but he is aware that confident conclusions cannot be drawn unless a large number of samples can be compared. The analysis of these few samples (all of alluvium) at the Forest Research Institute, Dehra Dun, showed that both the chemical and mechanical composition of the plantation and natural forest soils was very similar. The chief difference was found in the proportion of moisture and organic matter, though this amounted to an excess of only 2 per cent in favour of the natural forest soil.

Field observations, however, of alluvial soil under old plantation teak and under natural forest, show very distinct differences. The plantation soil is hard, compact and lacking in humus. The virgin forest soil is free, porous and often rich in humus. The ill-effects of non-porous alluvium on teak plants under Nilambur conditions is readily understandable. The alluvial lands are level or else have a very gentle slope, and the rainfall during the monsoon is very heavy. Under such conditions the surface layers become water-logged during continuous rain, and aeration of the soil is seriously impaired. During the severe dry weather which ensues, the soil becomes dessicated and harder than ever, and both dew, and the water precipitated by occasional showers, evaporate very rapidly from the caked surface. Ploughing (on an experimental scale) and digging the soil, after the monsoon, have each had such marked beneficial effects on young teak crops as to strengthen the theory that the "sickness" of the soil is largely mechanical. If such is really the case, the remedy is simple. There is reason to hope that satisfactory second crops of teak can be grown on the better soils, but it is difficult to be sanguine about the prospects of replanting teak on the laterite soils which grew indifferent crops in the first rotation.

24. "*Summary.*—In these plains the configuration of the ground, the depth of the soil and the degree of drainage are factors of very great importance which must never be lost sight of. They affect the quality of the locality for one and the same species; they affect the natural distribution not only of species but of the forests, and they must be the guiding factors in determining the species to be cultivated on any site under conditions necessitating artificial regeneration. In fact, too much emphasis cannot be laid on the importance of further study of these factors and their effect on growth. Their effect on growth is only an indirect result of their effect upon the physical properties of the soil. This effect may vary with every variation in the constitution of the soil. Local study of this question is, therefore, of primary importance." [R. Bourne.]

A special problem is presented by the conditions resultant on the exposure of the soil throughout one rotation of pure teak crops.

25. *Faulty selection of sites for teak in the past.*—The faulty selection of sites for teak planting in the past emphasises the importance of studying the effect, on tree growth, of the configuration of the ground and the depth and drainage of the soil. "Teak will not even survive either on laterite soils, where the laterite rock is near the surface, or under pronounced swampy conditions. These facts were recognized prior to 1860. The lesson, however, was not properly learnt. In the earlier years of planting, such sites were selected. Fortunately, however, neither were extensive. In later years, when the river banks around Nilambur had all been planted up, sites further from the rivers were selected for extension. The majority of such sites were on laterite soils on hillocks. The area of failure, due to laterite rock near the surface, very greatly increased. That such sites were not suitable was again realized and in further extension they were avoided. Unfortunately the assumption was still made that all river alluvium was suitable for teak. The locality selected for extension was one in which the belts of level land adjoining the rivers were broad. The greater part of such areas was planted up between 1897 and 1912 and the result has been a complete failure over large areas. So late as 1911, the cause of this failure was mainly attributed to want of labour to carry out the earlier weedings. There is, however, no doubt that with some exceptions, the real cause is the selection of sites unsuitable to teak on account of the bad drainage." [R. Bourne.]

During the last decade the proportion of unsuitable sites planted with teak has been greater than during any other period in the history of the plantations. The recognition, before clear-felling, of alluvial soils which are liable to turn into swamps when cleared of growth, is often extremely difficult. But mistakes have not been confined to such localities. Large areas of very shallow laterite soil have also been planted, though many of them are marked as unplantable in an old map recorded in the District Forest office. Such mistakes are to be deplored, but the continuous changes of officers make them readily understandable. Similar mistakes must be avoided in future, not only in the case of teak but also in the regeneration of other species. Suitable localities for different species are described in this working plan.

SECTION 4.—CLIMATE.

26. "*General.*—The difference in the elevation above mean sea level between the ghats and the plains has naturally considerable effect upon the climatic conditions.

27. *Temperature.*—The extremes of temperature in the shade in the plains vary approximately between 62° and 102° Fahrenheit. The differences between extremes within twenty-four hours rarely exceed 30°. These considerable extremes are due to the proximity of the plains forests to high hill ranges. The air, heated during the day, rises at night and is replaced by currents of cold air from the hills. The temperature at the summit of the Kundah Range sometimes descends to freezing point. The day temperature throughout is mainly dependent upon the rainfall and the hours of sunshine. The rainfall is sometimes incessant for days together. There is very little difference between day and night temperatures during such periods. More often, however, the rain alternates with bright spells of sunshine. During such periods and for some months after the principal rainfall, the daily temperature is about 80° Fahrenheit in the shade. It is naturally a damp heat peculiarly suitable for growth.

28. *South-west monsoon.*—The locality is subject to the South-west monsoon. This bursts between May and July, more often than not early in June. It is preceded in April and May, sometimes also in March, by thunderstorms, which, except on the face of the ghats, cause strictly local precipitation of rain. On the ghats the rainfall during these months is, in normal years, fairly general in the afternoons. These early rains are of extreme importance in the plains area, affecting, as they do, the length of the fire season, the commencement of the growing season and the germination of seeds." [R. Bourne.]

Though these early rains are very irregular, it seems possible that they can be used to greater advantage in the artificial regeneration of teak than has been the case in the past. Since it has been realized that the prospects of the second rotation plantations are less favourable than those of their predecessors, the importance of stimulating their growth in the first few years of life (the period of maximum activity) is more than ever obvious. It is most desirable to give the young teak seedlings the earliest possible start, and if, by direct sowing of prepared seeds during the pre-monsoon showers, a reasonable stocking can be obtained, the seedlings will establish themselves early and will be able to make the most of the growing weather in the beginning of the monsoon. For breaks in the monsoon are much more common in the early weeks than later. Spells of sunshine between bursts of rain are most favourable to established growth, but they mean death to plants which have not had time to establish themselves before the rain stops. Heavy casualties from this cause are common when planting is done, as it should be done, in the beginning of the monsoon. Final replacement of casualties is often not completed till August, when the monsoon is nearly over, and the most that can be hoped for these late plants is that they will survive their first hot weather. Little growth can be expected of them. Two small experiments with direct sowing of teak seeds were made in 1926 a most unfavourable year as regards pre-monsoon showers. Their results were sufficiently encouraging to warrant further experiment, on a larger scale, and prescriptions to test the rival merits of sowing and planting are made.

The heaviest rainfall of the south-west monsoon generally occurs in July, when very high floods may result.

29. "*North-east monsoon.*—The period of heavy precipitation is generally followed by breaks, late in August and through September, followed again by heavier precipitation in October, which may or may not be an indirect result of the north-east winds." [R. Bourne.]

30. *Dry weather.*—From the middle of December to the end of March the rainfall is, as a rule, negligible, and, more often than not, the April showers do not commence before the middle of that month. For four months, therefore, young regeneration has to undergo a very critical time, and though mortality is not high in the case of teak, provided it has had an early start, the greatest difficulty has been experienced in regenerating species which are of tardy development, and which are incapable of the early production of a drought-resisting root.

31. *Rainfall.*—The average annual rainfall measured at Nilambur for the ten-year periods 1889—98, 1899—1908 and 1909—18 is 104·52, 114·52, and 107·84 inches respectively. On account of the Moplah rebellion in 1921 and 1922

the records for these two years are not complete. For the seven years between 1919 and 1927 for which there are complete records, the average annual rainfall is 126·90 inches. The increased average of recent years is due to the unusually heavy rain in July and August 1923, and to the unprecedented precipitation in July 1924 when over 90 inches were recorded at Nilambur, and when the worst floods within living memory were experienced, both here and in other parts of the Madras Presidency.

It is believed that the readings recorded at Nilambur hold good for most of the forests in the plains. But there is no doubt that the rainfall on the ghats is considerably heavier, especially in the months of April, May and November, and that a belt of country, several miles wide, between the foot of the hills and Nilambur, receives an annual precipitation appreciably heavier than at Nilambur, though probably less than on the face of the ghats. There is no measuring station in either of these two zones, but provision is made, in this plan, for the establishment of a station at Nedungayam.

The following table shows the monthly rainfall measured at Nilambur from 1889 to 1927, omitting the years 1921 and 1922 :—

Extract from the rainfall register of Nilambur station from January 1889.

Year.	Months.												Total in each year.
	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
1889	..	..	..	3 95	2·40	24 67	20 47	18·99	18·49	15·34	0·25	2 07	101·63
1890	..	..	1·42	4·93	5·13	21 02	17·31	7·36	2·40	2·63	2·21	0·05	64·46
1891	..	0·65	0·70	1·90	4·50	11·40	39·10	13·87	2·05	9·72	1·10	0·13	85·12
1892	..	..	..	4·62	7·12	13·58	60·07	22·72	3·58	15·23	1·65	0·02	128·59
1893	..	1·48	2·13	0·58	3·35	28·92	11·16	10·82	7·93	10·05	8·81	..	85·23
1894	..	0·20	1·86	2·70	1·46	27·48	24·88	16·96	2·56	8·36	4·66	0·02	91·14
1895	..	..	..	3·90	2·58	34·55	29·19	16·87	8·42	20·81	3·15	..	119·47
1896	0·02	.	..	1·14	2·68	45·10	51·74	15 83	2·80	4·10	4·78	5·30	133·49
1897	..	1·65	..	3·14	2·65	40·38	37·54	40 28	7·25	6·21	4 87	..	143·97
1898	..	0·15	..	1·17	4·08	25 97	26·21	4 41	9·06	14·15	6 89	..	92 09
Total ..	0·02	4·13	6·11	28·03	35·95	273·07	317·67	168·11	59·54	106·60	38·37	7·59	1,045·19
Average ..	..	0·41	0·61	2·80	3·59	27·31	31·77	16·81	5·95	10·66	3·84	0·76	104·52
1899	..	..	..	9·10	2·88	28·64	21·85	6·88	2·72	7 22	0·34	..	79·63
1900	..	..	..	5·35	1·93	33·49	59·71	48·46	7·05	9·06	0 58	0·68	166·31
1901	0·15	0·46	0·33	4·01	1·66	30·06	43·12	13·01	11 44	11·07	11·30	1·95	128 56
1902	0·23	0·20	2·06	2·70	2·37	11·02	48 00	5 08	18·94	15 78	7·45	5·81	119·64
1903	..	..	..	..	4·21	17·80	45 88	11 76	8 30	9·62	13·37	0·50	111·44
1904	1·03	..	..	2·19	6·59	51·58	33·81	17 80	8 35	11·17	0·82	..	133·34
1905	..	..	..	0·55	3 08	32·89	28 78	10·44	6·83	17·53	3·03	..	113·13
1906	0·76	..	0·03	0·75	3·34	9·92	33·95	10·80	3·49	4·89	4·48	2·02	74·43
1907	..	..	0·83	3·30	2 02	31·92	35 64	43·74	6·10	12·43	3 33	2·27	141·58
1908	..	0 93	1·43	2 58	3·48	17·24	32·04	11·47	2·61	4·97	0·03	0·40	77·18
Total ..	2·17	1·59	4·68	30·53	41·56	264·56	382·78	17·944	75·83	103·74	44·73	13 63	1,145·24
Average ..	0·22	0 16	0·47	3·05	4·16	26·46	38·28	17·94	7·58	10·37	4·47	1 36	114·52
1909	1·45	..	0·61	1·61	18·84	30·01	30 30	9 91	7·69	11 80	4·30	1·10	117·62
1910	..	0·52	0·86	1·85	3·11	24 19	17·13	18·67	9·98	15·54	6 44	..	98·29
1911	..	0 03	0·34	0 70	3·06	57·97	44·71	6·94	0·96	8·25	3·47	0·41	126·84
1912	..	..	..	1·62	4·50	39·40	44·99	13·96	3·03	10·17	4·56	..	122·23
1913	..	..	..	1 19	6·02	21·56	39·96	10·74	5·89	17·92	1 60	0 18	105·06
1914	..	..	..	..	0 69	20 31	45·75	11·67	6 72	20·72	1·29	3·52	110 67
1915	..	..	0·56	2 59	1·25	28·04	22 12	16·76	10·68	10·63	10·41	1·82	104·86
1916	..	..	0·18	2·12	5·29	34·73	20 64	21·94	12 94	7·99	2 12	2·00	109 95
1917	..	0·91	0·90	1·29	2·64	24·01	13 72	8·63	20·57	16·40	10 08	0·69	99 84
1918	0·02	..	0·04	0·89	22·55	12·32	6·52	18·05	1·93	11·24	8·49	0·98	83·03
Total ..	1·47	1 46	3 49	13·86	67·95	292·54	285 84	137·27	80·39	130·66	52·76	10·70	1,078·39
Average ..	0·15	0·15	0·35	1·39	6·79	29·25	28·58	13·73	8·04	13·07	5·28	1·07	107·84
1919	0·46	0 10	.	2·42	5 47	38·00	28 00	20 68	10·05	9·22	11·48	0·93	126·81
1920	1·34	..	0·02	9·78	3 62	25·66	48 78	3 71	3·92	11·18	7·18	..	115·19
1921	..	..	..	Records incomplete.				..	..	..	..	..	
1922	..	..	..	Do.				..	..	..	..	..	..
1923	..	..	0·35	1·21	4·52	19·88	57·27	55 05	4·93	5·56	1·79	0·19	150 75
1924	2·77	..	1·32	0 42	3·71	29 87	90·76	19 97	6·91	6·41	2·63	1·53	166·30
1925	..	..	0·85	3·18	6·08	21·26	31·38	24·39	4·52	10·05	5·17	2·23	109 11
1926	0·15	..	0·17	..	3·35	16·21	50·81	29·52	10 16	6·39	2·30	0·04	119 10
1927	..	..	0·08	2·06	7·56	26·71	34·03	17·42	8·69	1 63	2·86	..	101·04
Total ..	4·72	0·10	2·79	19·07	34·31	177·59	341·03	170·74	49·18	50 44	33·41	4·92	888·50
Average ..	0·67	0·01	0 40	2·72	4·90	25 37	48·72	24·39	7·03	7·21	4·77	0·70	126·90

32. "*Winds.*—The prevailing winds are from the south-west from April to September and from the north-east from November to January. In October the prevailing wind varies from one to the other of these two directions. During the dry weather, from January to March, there are generally slight sea breezes from the west during the day, changing to a strong breeze from the north, north-east or east, according to circumstances, in the evening. These breezes are attributable to the air currents normal to such a locality as this, which is situated at the foot of high hill ranges.

33. *Storms.*—Gales are experienced during the months of April, May, June, July and October. During such gales whirlwinds often occur. They originate, it is believed, in the river-beds, particularly that of the main river, which is broad and very deep. The depth is accentuated in many places by forest over 100 feet in height on each bank. Their course can be traced by the damage they do This is particularly noticeable in localities where the river-bed runs at right angles to the prevailing wind directions. Their usual course indicates that they never go far from the river bank and generally seem to return to the same." [R. Bourne.]

34. *Summary.*—The climate may therefore be considered equable, though it is characteristically humid and hot. The Amarampalam range is very feverish during the months of February, March and April, but the health of the subordinates has improved considerably since they moved to Karulai from their old quarters at Nedungayam. It is believed that there is little danger of malarial infection in Nilambur, and that the fever from which the subordinates often suffer is contracted in outlying localities rather than in Nilambur. Influenza, and chills which bring out latent malaria, are fairly common in the wet weather. On the whole, the climate can hardly be called unhealthy, though it is enervating.

Section 5.—Water-supply.

35. *Water-supply.*—The forests of the valley have an abundant supply of water, chiefly from the three large rivers and their tributaries. The more important headquarters of subordinates, and the chief camps are also supplied with wells. In none of the places where work is prescribed in this working plan should there be any scarcity of water for men or elephants. In the hot weather, water is scarce in many parts of the Inaccessible Working Circle, at higher elevations, but since it is not proposed to work these forests in the immediate future, the question may be left for future consideration.

Section 6.—Distribution and Area.

36. *Division into ranges.*—The areas covered by this working plan, amounting to 81,031·30 acres, are divided into two forest ranges, the Nilambur and the Amarampalam ranges. The headquarters of the Nilambur range are at Nilambur, while those of the Amarampalam range are at Karulai, six miles distant from Nilambur, in an easterly direction.

37. *Nilambur range.*—The Nilambur range consists of a number of blocks, of which some are contiguous and some isolated. Their total area is 13,399·3 acres. The following blocks constitute a more or less compact block around Nilambur—Edakode, Valichapali, Elenjeri, Ramalur, Moolathamanna, Arevakode and Aravallikava, situated to the west and north-west of Nilambur; Pannengode, Walluvasseri, Pokode, Chatomborai and Kanakuth, to the north, north-east and north-west. The total area of the above blocks is 9,181·7 acres. Within ten miles of Nilambur to the north-east, there are three outlying blocks, Erambadam, area 592·7 acres, Kariem and Muriam, area 2,766·1 acres. Old Amarampalam, area 497·5 acres, is seven miles south-east of Nilambur. In addition there are five small outlying blocks of the west, about half-way down the river between Nilambur and the coast; their total area is 361·3 acres.

38. *Amarampalam range.*—The forests of the Amarampalam range comprise one compact area, consisting of the New Amarampalam, Karumpoya and Nellikutta reserves, with a total area of 67,632 acres.

39. *Survey and maps.*—The whole area under this working plan was surveyed by a Government of India Survey Party in the seasons 1907–1909. Topographical maps on the 2″ and 1″ = 1 mile scales are available for the whole area. The former, alone, have been supplied to the forest office. In addition, all areas planted with teak between the years 1842 and 1912 were surveyed and mapped by a Surveyor and Traverser of the Government of India Survey in the seasons 1916–17, and detailed topographical maps of these areas on the 8″ = 1 mile scale are available. The latter maps were used by Mr. Bourne for stock-mapping the teak plantations for the preparation of the last working plan, and they have been used in this revision also. The plantation stock-maps, showing topography, have been found extremely useful by executive officers. A stock-map of the natural forests, reduced from the 2″ to the 1″ = 1 mile scale, was also published with Mr. Bourne's working plan. It differentiates between timber forest, bamboo forest and swamp ; drawn by eye, on a small scale, it is not very accurate. Areas of natural forest artificially regenerated from 1916 to 1927 have been surveyed, from time to time, by the staff of the division, and mapped on the 8″ = 1 mile scale. These maps do not show topographical details ; the surveying was done by prismatic compass and in most cases no allowance was made, in plotting, for magnetic variation. In 1924–25 most of the Nellikutta reserve was mapped and "cruised" by a party under the Logging Engineer, Madras. A topographical map, with contours at ten feet vertical intervals, and cover maps showing the stand of timber and the areas covered by bamboo, are available. A Madras Revenue Survey Party has been engaged from 1925 to 1927 in a resurvey of the forests of the division. Their sketches have been received in the District Forest Office and are being verified. They appear to have made many mistakes by following existing exterior fire lines instead of tracing out the old survey stones. These maps will, presumably, be corrected by the Madras Revenue Survey before final preparation.

40. *Area figures adopted.*—In the preparation of this working plan the area figures adopted, for whole reserves and blocks, are those furnished by the Government of India Survey. The areas of enclosures not in the possession of Government have been determined from revenue records, as they were not surveyed by the Government of India Survey Party. The areas for all smaller divisions have been computed by planimeter. Where no alterations have been made in Mr. Bourne's working plan maps his area figures have been accepted.

41. *Abridged table of areas.*—An abridged table of areas of reserves and blocks is given below. The total areas of reserves and blocks are the same as in 1918, with the exception of the New Amarampalam reserve which is now reduced by 125 acres, owing to the disreservation of some swamp land to the north of Nedungayam—Notification No. 411, dated 10th December 1926, under *section* 24 of the Madras Forest Act V of 1882.

Name of reserve or block. (1)	Area in acres. Of riverbed. (2)	Under cultivation. Private included in G of I survey areas. (3)	Under cultivation. State included in G of I survey areas. Leased by Forest Department. (4)	Under cultivation. State included in G of I survey areas. Leased by Revenue Department (disreserved.) (5)	Plantation Working Circle (includes teak plantations, blanks, failures, firelines, etc.) (6)	Conversion Working Circle. Areas planted from 1916 to 1927. (7)	Conversion Working Circle. Natural forest and swamp. (8)	Conversion Working Circle. Total. (9)	Inaccessible Working Circle. (10)	Grand total, G of I survey. (11)	Grand total in possession of the State. (12)	Grand total under the provisions of the working plan. (13)
Nilambur Range.												
Valichapalli and Edakode.					1,260·4	..	3,088·4	3,088·4	..			
Elenjeri					339·1	..	..	..	..			
Ramalaur	190	200·9	..	..	47·0	..	..	..	..	5,453·0	5,252·1	5,252·1
Moolathamanna ..					75·2	..	..	..	..			
Arevakode					110·1	..	..	..	..			
Aravallikava ..					141·9	..	..	..	..			
Pannengode ..	25	63·1	..	..	604·0	..	282·9	282·9	..	975·0	911·9	911 9
Walluvasseri ..	30	..	..	..	724·2	117·9	77·9	195·8	..	950·0	950·0	950·0
Pokode	17	138·7	..	..	263·9	..	478·4	478·4	..	898·0	759·3	759·3
Chatomborai ..	41	69·0	..	..	486·2	..	122·8	122 8	..	719·0	650·0	650·0
Kanakuth	..	69·6	..	..	..	87·7	570 7	658·4	..	728·0	658 4	658·4
Erambadam	..	75·3	..	..	..	..	592·7	592 7	..	668·0	592·7	592·7
Old Amarampalam ..	13	4·5	1·4	..	420·2	34·5	28 4	62·9	..	502·0	497·5	497·5
Kariem	..	33·9	..	..	..	..	962·1	962·1	..	996·0	962·1	962·1
Muriam	..	..	..	..	..	..	1,804·0	1,804·0	..	1,804·0	1,804·0	1,804·0
Arimbrakutta ..	..	16·8	..	..	86·5	..	234·7	234·7	..	338·0	321·2	321·2
Ambalakandi ..	..	..	..	..	1·2	..	..	..	..	1·2	1·2	1·2
Chaliyapuram .. Mangalasseri ..	..	..	..	..	10·5	..	..	..	..	10·5	10·5	10·5
Puthalath and Chittarikal.	..	..	..	..	8·2	..	..	..	..	8·2	8·2	8·2
Pozhayi .. .. Mangalasseri ..	..	..	..	..	20·2	..	..	..	..	20·2	20·2	20·2
Total ..	316	671·8	1·4	..	4,598·8	240·1	8,243·0	8,483·1	..	14,071·11	13,399·3	13,399·3
Amarampalam Range.												
Nellikutta	6	..	..	..	122·7	..	1,870·3	1,870·3	..	1,999 0	1,999·0	1,999·0
Karumpoya	428	..	..	..	1,856·3	520·9	1,208·8	1,729·7	..	4,014·0	4,014·0	4,014·0
New Amarapalem ..	348	..	164·9	125	13·2	257·6	12,536·3	12,793·9	48·299	61,744 0	61,744·0	61,619·0
Total ..	782	..	164·9	125	1,992·2	778·5	15,615·4	16,393·9	48·299	67,757·0	67,757·0	67,632·0
Grand Total ..	1,098	671·8	166·3	125	6,591·0	1,018·6	23,858·4	24,877·0	48·299	81,828·11	81,156·3	81,031·3

SECTION 7.—STATE OF THE BOUNDARIES.

42. "*Natural boundaries.*—Most of the exterior boundaries of the forests are rivers and streams. In some such cases field survey stones have been planted along the river bank, at the time of Revenue Survey in 1896. In every such case, however, the river or stream is the actual boundary, and no special steps have or need be taken, therefore, to demarcate them. With the exception of the eastern boundary of the New Amarampalam reserve, which runs along the summit of the Kundah range, coincides with the Malabar-Nilgiri district boundary and is demarcated with stone cairns, the remaining exterior boundaries are indicated by cleared lines.

43. *Artificial boundaries.*—The majority of the forest blocks in the Nilambur range have been surveyed at the so-called forest survey of 1870, and by the Revenue authorities in 1896. In such cases there are field survey stones planted along these cleared lines; also around enclosures." [R. Bourne.] Between the years 1916 and 1921, small pillars, built of laterite stones in chunam, were erected beside such survey stones in the following blocks:—Moolathamanna, Ramalur, Elenjeri, Aravallikava, Arevakode, Pannengode, Walluvasseri, Pokode, Chatomborai, and part of Kanakuth. During the year 1926 wooden posts were planted beside the survey stones at the more prominent bends of the exterior boundary, and of the enclosure boundaries, in the Edakode and Valichapali blocks. Permanent demarcation is still incomplete, which is regrettable, because the Revenue survey stones are extremely difficult to trace in a locality of such luxuriant growth, and the latest resurvey shows that, in many cases, the cleared lines, as maintained at present, do not follow the actual boundary.

44. *Importance of final demarcation.*—The importance of permanent demarcation will be realized when it is considered that almost all the Government forests adjoin private forests, waste and cultivated lands. Further, especially in the case of the leased forests, failure on the part of Government to maintain the boundaries correctly, might conceivably lead to further legal disputes, of which there are more than enough already.

45. *Register boundaries.*—Prior to the Malabar Rebellion of 1921 a register of boundaries was recorded in the District Forest Office. It contained the field measurements recording the angles and distances of the exterior boundaries and of the boundaries of enclosures of all surveyed blocks, and the correct descriptions of all exterior boundaries of unsurveyed blocks. This register was destroyed when the office was burnt. The opening of a new register of boundaries is prescribed in this working plan. The names and owners of all lands adjacent to areas surveyed during the preparation of Mr. Bourne's working plan are posted on the 8″=1 mile maps of the plantations.

SECTION 8.—LEGAL POSITION.

46. *General.*—All the forests covered by this working plan are either leased from private owners or have been purchased by the State.

A.—Leased Forests.

47. *From Trikkalayur devaswam.*—The principal lease is with the Trikkalayur devaswam or pagoda. The manager of the devaswam is known as the Uralan. The forests held under the original lease consisted of the following blocks of the Nilambur range:—Edakode and Vallichapali, Elenjeri, Ramalur, Arevakode, Aravallikava, Pannengode, Pokode, Walluvasseri, Kanakuth, Erambadam, Kariem and Muriam, Arimbrakuttamala, Ambalukandi, Mangalasseri (Calicut), Mangalasseri (Ernad), and Puthalath and Chitarikal. In addition, stump fees were paid and accepted in respect of the Moolathamanna block, though it was not named in the lease, and was, in fact, lease from the Nilambur Tirumalpad in 1858, though the lease was lost sight of by both lessor and lessee, and the block was wrongly included in the revised lease with the devaswam in 1917.

" (*a*) *Conditions of lease.*—Under this lease or karar, which was executed on the 10th December 1840, Government entered into possession of the above blocks, free of all rights, except rights to minor produce, of washing for gold, of elephant-capturing and of access to enclosures. In addition, the devaswam retained the right to be allowed a limit of 100 trees every twenty years for repairs to their temple. In return Government paid down Rs. 1,000 as mortgage fee and an advance of Rs. 7,000, free from interest.

(*b*) *Payments due.*—The devaswam were to be paid, from time to time, sums due on kuttikanam or stump fee at Re. 1 per tree, payable for every tree felled of teak, blackwood, cedar or poonspar, over three borrels thick (eight inches quarter girth at about twenty feet from the ground) existing at the time of execution of the lease. These sums were to be recovered from the advance of Rs. 7,000, until such time as recovery had been completed, and were then to be paid in cash. Kuttikanam was also to be paid at the rate of half a rupee per tree on all saplings of the above species which were under three borrels thick at the time of the execution of the lease, and on all planted teak, when they, on becoming fit for cutting, shall be cut and removed. In this connexion it was subsequently decided by Government that no kuttikanam was to be paid to the devaswam on account of teak saplings, under three borrels thick, removed in thinnings. Finally, kuttikanam was to be paid on all junglewoods, bamboos, etc., felled, according to the custom of the country. In this connexion it was subsequently decided and mutually agreed upon that the devaswam should be paid 50 per cent of the net profits on all junglewood, etc., felled in the ordinary course, and 20 per cent only, if felled in clearings for new plantations.

(*c*) *Conditions of renewal.*—The lease was to be renewed every thirty years on payment of a renewal fee of Rs. 200.

(*d*) *Rules under section* 33 (*a*), *Madras Forest Act.*—In October 1900, rules were notified under section 33, clause (*a*) of the Madras Forest Act V of 1882—(vide B.P. Forest No. 496, dated 5th December 1900), applying the provisions of

clauses (*b*), (*c*), (*d*) and (*f*) of section 26 of the said Act, to these forests. In August 1903 a notification was published, in the supplement to the district gazette, defining the areas under special fire protection and the public and private rights of way therein.

(*e*) *Negotiations in the past resulting in revision of the deed.*—Negotiations were set on foot, from time to time, to get the devaswam to surrender their rights to minor produce, etc. These negotiations culminated in the execution of a new demise and lease on the 5th March 1917.

(*f*) *Revised conditions.*—The new demise and lease, which has to be renewed every thirty years, by payment of a renewal fee of Rs. 200, is determinable only at the will of the lessee, or on default by the lessee to pay the above renewal fees. It is free from all rights, except the right of the devaswam to a certain number of trees every twenty years for the repairs to their temple." [R. Bourne.] The Moolathamanna block was wrongly added to the schedule of the revised lease, drawn up on behalf of Government by the District Forest Officer, South Malabar, and the Collector of Malabar, and accepted by the Uralan.

" (*g*) *Payments due.*—In return, Government agreed to loan to the devaswam, before the execution of the lease, a sum of Rs. 12,000 at 3½ per cent compound interest, repayable in fifteen annual equal instalments of Rs. 1,042.

(*h*) *Fixed annual rental.*—Further, that Government would pay to the devaswam, on or before 15th February in each year, commencing from 1917, an annual rental of Rs. 1,500 in lieu of kuttikanam. The recovery of Rs. 1,042 during the first fifteen years was to be deducted from the sum of Rs. 1,500 before payment." [R. Bourne.]

(*j*) *Subsequent alterations.*—The protracted dispute between the devaswam and the Tirumalpad of Nilambur, over the ownership of the Kariem and Muriam forests, is described in the next paragraph. The District Court, Calicut, decreed, in 1924, that only five thirteenths of the Kariem and Muriam blocks are the jenm property of the devaswam, and that the balance (or eight-thirteenths) belongs to the Tirumalpad, and that the Government must pay to the Tirumlapad the kuttikanam wrongly paid to the devaswam in the past. This was assessed at Rs. 3,996–3–11, and it has been paid. Following the court decree, the Collector of Malabar reduced the annual rental from Rs. 1,500 to Rs. 1,281–12–5 on account of the exclusion of the area admitted as belonging to the Tirumalpad. The reduction was made in accordance with the proportion existing between the area thus excluded and the total area under the 1917 lease. The lease, however, has not yet been amended in the respect, nor has the Moolathamanna block been excluded.

(*k*) *Final settlement pending.*—The Uralan of the devaswam has appealed to the High Court against the decision of the Calicut District Court, but the appeal has not been heard up to the time of writing this working plan. To recover the amount of Rs. 3,996–3–11 involved in the court decree of 1924, and also the excess rent paid to the devaswam from 1st April 1918 to 31st March 1923, Government sued the devaswam and got a decree in 1927 in the Calicut Sub-Court for Rs. 4,367–15–11. This amount has not yet been paid, but it is understood that certain lands of the devaswam in the Walluvanad taluk are to be attached and sold, in order to realize the amount of the decree.

(*l*) *Total payments and cost value of land in* 1840–41.—The total amount disbursed in respect of the devaswam leased forests, under the original lease, is Rs. 49,295–13–7. Mr. Bourne has calculated that the present value in 1840–41 of all sums paid and to be paid under both leases (for 12,251·8 acres) amounts to Rs. 17,667 or Rs. 1,442 per acre. He included, in his calculations, the small sums paid to the Tirumalpad. In view of the decree of the Calicut District Court in 1924, the payments made from 1924 onwards have been less than the payments anticipated by Mr. Bourne. But while the ownership of the Kariem and Muriam blocks is the subject of an appeal which is pending in the High Court, and until a definite decision has been reached in respect of Moolathamanna, the need for re-calculating the present value will not arise.

48. *From Nilambur Tirumalpad.*—The next leases to be considered are those with the Tirumalpad of Nilambur, in respect of portions of the Kariem and Muriam forests and of the Moolathamanna block.

(*a*) *Jenm title to Kariem and Muriam disputed.*—" In 1843, soon after the execution of the Trickalayur devaswam lease, the Nilambur Tirumalpad claimed that, out of the nine hills constituting Kariem and Muriam block, leased by the devaswam, two hills Valia and Cheria Karien Malas were his jenm property. To safeguard their possession of the lands taken up, the Government accordingly, without investigation of the Tirumalpad's claim, took a lease from him for his Valia and Cheria Karien Malas. "—(R. Bourne). The ownership of the Kariem and Muriam forests has been disputed, in and out of court, up to the present day. The latest development is the decree of 1924 of the Calicut District Court, in the suit filed in 1918 by the Tirumalpad. The court found that eight-thirteenths of the Kariem and Muriam blocks (including the whole of Kariem, and two portions of Muriam, one in the north, and the other in the south-east) amounting to 1,674½ acres, are the jenm property of the Tirumalpad, and ordered Government to pay the latter a sum of Rs. 3,996–3–11 on account of kuttikanam wrongly paid to the devaswam up to the year 1918. Government have paid the amount. The devaswam have appealed to the High Court against the decree of the lower court in favour of the Tirumalpad, and the appeal is still pending.

(*b*) *Conditions of lease.*—An agreement signed on 9th January 1843 defines the rights of Government in the Tirumalpad's forests then described as Cheria Karien Mala and Valia Karien Mala. Felling of all trees and bamboos of natural origin was permitted subject to payment of kuttikanam at the rate of Re. 1 per tree in the case of teak, blackwood, poon and cedar, and kuttikanam 'according to the custom of the country' in respect of 'aini, irool and other junglewoods and bamboos.' Permission to plant teak was accorded, on condition that stump fees of half a rupee per tree should be paid on felling such teak trees. Timber was to be checked at the river side by the Tirumalpad's representative. For transport of timber from the forests leased by him, the Tirumalpad agreed to allow Government to construct such roads as were necessary. He reserved his rights to elephant tusks, however obtained, to elephant capturing and to gold washing in the leased forests. The lease is determinable only at the will of the lessee, provided that stump fees are paid as laid down.

" (*c*) *Payments made and withheld.*—In 1870–71 and 1878–79, small amounts were paid to the Tirumalpad as kuttikanam in respect of Kariem. Since 1893–94 all amounts due on kuttikanam in respect of both Kariem and Muriam have been withheld from payment up the time of the execution of the new lease with the devaswam, when this amount of Rs. 1,746–8–7 was paid to them. All the sums paid in respect of Kariem and Muriam have been included in the amount of Rs. 49,295 odd, shown as paid under the old lease in respect of all the devaswam leased lands. " —(Mr. Bourne). Since 1917 (the year of the new lease with the devaswam) a sum of Rs. 10,385–0–11 has been paid to the Nilambur Tirumalpad in respect of the Kariem and Muriam forests. Of this sum Rs. 3,996–3–11 represent the amount of the court decree of 1924, and Rs. 6,387 represent kuttikanam on bamboos, at the rate of Rs. 3 per 100, cut in these forests from 1910 to 1923. The cost value of the portions of Kariem and Muriam leased from the Tirumalpad need not be calculated until the High Court judgment is received, as further adjustments of stump fees and areas are possible.

(*d*) *Moolathamanna block.*—In 1847 the Tirumalpad of Nilambur agreed to lease to Government an area of forest in the locality known as Moolathamanna. Government commenced teak planting operations in the same year, and planting was completed in 1853, though the lease was not drawn up and signed till 1858. In this karar kuttikanam at the rate of Re. 1 per tree was demanded when the time came for felling 340 teak poles and sapplings which existed in 1847 and which were retained when the land was cleared for planting, and at the rate of eight annas per tree on teak planted by the Government. Future felling of 'aini, irool and other junglewoods and bamboos' which might grow on the land was subject to kuttikanam 'according to the custom of the country', but no claim was made on account

of the trees felled in clearing the land for plantations. In his report of 1878 Colonel Beddome stated that the Moolathamanna block was held on lease from the Tirumalpad, but when the Tirumalpad claimed the land in the court of the Forest Settlement Officer appointed in 1888, his claim was rejected. This decision was upheld by the District Court, Malabar, on appeal, but was set aside, on the second appeal, by the High Court (No. 45 of 1894). (Up to this time it is apparent that the necessity for paying kuttikanam had not arisen.) Subsequent to the High Court's disposal of the case in favour of the Tirumalpad, the karar of 1858 seems to have been lost sight of, both by the Forest department and by the Tirumalpad, and when some bamboos were felled in the block in 1905-06, kuttikanam was paid to the Trickalayur devaswam, although the land was not included in the devaswam's lease current at that time. Further payments of kuttikanam, both on account of bamboos and of teak thinnings were paid to the Devaswam up to the year 1913-14, and when the devaswam's lease was revised and renewed in 1917, the Moolathamanna block was included in the schedule. The existence of the 1858 karar was not re-discovered till 1924-25 when final fellings were commenced in the Moolathamanna plantations and the Tirumalpad claimed kuttikanam. Owing to the destruction of the District Forest Officer's records in the Malabar rebellion, nothing was known about the Tirumalpad's alleged rights, but the Collector of Malabar obtained a copy of the karar of 1858 from the Registrar's office, and the matter is still under correspondence. The boundary descriptions in the karar are very vague, and it remains to be determined whether the whole or only part of the Moolathamanna block belongs to the Tirumalpad. That some of the land belongs to him is certain, but it is doubtful whether he owns it all, and if it is decided that his jenm title extends only to a portion of the land, the question of ownership of the remainder will have to be decided. All payments of kuttikanam in respect of Moolathamanna have hitherto been made to the devaswam, and the block is still included in the devaswam's lease. When the extent of the Tirumalpad's ownership is decided he will have to be paid kuttikanam in respect of recent final fellings, and also (probably) on account of payments wrongly made to the devaswam in former years, though he has not as yet laid any claim to the latter. The cost value of the Moolathamanna block cannot be calculated until these questions are cleared up.

(*e*) *Operation of the leases and need for revision.*—When the controversies about the ownership of the Moolathamanna, Kariem and Muriam forests are ended, the old leases of 1858 and 1843 will have to be revised. Clear boundary descriptions will be necessary, and the system of payment will have to be put on a more precise and equitable basis. As far as Moolathamanna is concerned the rates for kuttikanam, as laid down in the old karar, do not operate disadvantageously to Government, for practically all the trees are teak, planted by the Forest department, and a stump fee of eight annas, provided it is not demanded on small poles, is a low rate of seigniorage at the present day. But in the case of Kariem and Muriam the application of the old karar must impose restrictions on the administration of these forests. The Tirumalpad interprets the phrase 'the custom of the country' as meaning the rate of stump fee which he charges to private individuals who exploit his other forests which are in his own management. This interpretation, though probably correct, is manifestly unfair to Government, for the same terms could be obtained by taking contracts in the Tirumalpad's private forests, without incurring the expenses of administration. As an example of the operation of this interpretation a recent case may be quoted. The department felled a mango tree while clearing an area for re-planting in Moolathamanna, and the Tirumalpad has claimed a stump fee of Rs. 10 for it. If such a fee is demanded for timber that has an extremely low market value, one must expect that the rates payable for working the Kariem and Muriam forests will be a very heavy charge, since practically all the exploitable trees are of species which come in the old category of 'junglewoods', for which the rate of stump fee was not fixed. Unless a more equitable arrangement can be made, it is unlikely that selection fellings of any species other than Xylia Xylocarpa (which can be extracted cheaply in the form of sleepers) will give a safe margin of profit after deducting kuttikanam. It is in the interests of the lessor to be reasonable in his demands, for Government is under no obligation to fell any tree whatsoever, and, indeed, cannot do so if stump fees are excessive.

49. " *From Zamorin Raja of Calicut.*—The next lease to be considered is that with the Zamorin Raja of Calicut, in respect of Nellicutta block. It was executed on the 10th November 1841.

(*a*) *Conditions of lease.*—Under this lease the Zamorin surrendered all rights, except rights to collect elephant tusks, to capture elephants, and to wash for gold.

(*b*) *Payment due.*—In return, Government were to pay kuttikanam at Re. 1 per tree on all teak, blackwood, cedar and poonspar, that may be felled, whether existing, or might grow, or be planted. Kuttikanam was also to be paid on all junglewoods, bamboos, etc., according to the custom of the country. In this connexion the Zamorin subsequently agreed to Government's decision to pay 50 per cent of the nett profits on all ordinary fellings and 20 per cent on clearings for planting. A fixed rental of Rs. 13-1-0 was to be paid in return for the right of collecting minor produce. The Government's decision not to pay kuttikanam on saplings, under three borrels thick, removed in thinnings, was applied also to this lease.

(*c*) *Lease revised.*—On the 15th October 1885, a second lease was executed, under which the Zamorin surrendered his rights to elephant tusks, elephants and washing for gold, on condition that Government paid 40 per cent on all profits on gold washing and elephant tusks, and 25 per cent of the value of all elephants captured, as mutually agreed upon by both parties, or failing such mutual agreement, the Zamorin, in return for the elephant, paid 75 per cent of the value, as fixed by him.

(*d*) *Notification under section* 25 *of the Madras Forest Act.*—In March 1886 the Nellicutta reserve was notified under section 25 of the Madras Forest Act V of 1882 (vide Notification No. 189, dated 15th March 1886)." [R. Bourne].

(*e*) *Further revision.*—In 1917 it was proposed that the existing lease should be superseded by a revised lease, on the basis of a fixed annual rental. Government offered Rs. 700 per annum, but the Zamorin declined the offer and the negotiations fell through. In 1924 Government renewed the offer, and this time, realising that the terms were particularly favourable to him, the Zamorin accepted, and a new lease was signed on 30th September 1924. Though the system of a fixed rental is more satisfactory, as far as administration is concerned, than the old stump fee arrangement, it must be pointed out that Government fares badly under the new terms. All things considered, a rent of Rs. 700 per annum for this block is excessive.

(*f*) *Revised conditions.*—The new lease has effect from 1st April 1924, for such period as the lessee may require. Government has to pay an annual rental of Rs. 700, and also 40 per cent of the profits on gold washing, as well as undertaking the liability for all taxes and assessments, present or future, in respect of the leased land. Subject to these conditions Government has the unrestricted use and enjoyment of the property.

(*g*) *Total payments and cost value of land in* 1841-42.—The total amount disbursed to the Zamorin under the leases of 1841 and 1855, up to and including 1924-25, is Rs. 21,416-6-3—see Chapter VII. The present value in 1841-42 of all sums paid and to be paid in future in respect of this area of 1,999 acres amounts to Rs. 4,823, or Rs. 2·413 per acre. Rupees. 2·413 per acre represents, approximately, the cost value of the land in 1841-42.

50. " *From Wandur Nambudripad.*—The last lease to be considered is that with the Wandur Nambudri or Edavanna kovilagam in respect of Chatomborai block. This lease was executed on the 6th of April 1871.

(*a*) *Conditions of lease, payments due.*—This lease is free of all rights. In return, Government assigned Rs. 5,000 to the kovilagam and were to pay kuttikanam, at Re. 1 per tree, on all teak, karimaram (ebony), benteak, blackwood, cedar and poonspar that may be felled, whether natural or planted, as fit to be measured and for sale. Government's decision not to pay kuttikanam on saplings, under three borrels thick, removed in thinnings, was applied also to this lease."—[R. Bourne]. The lessor is now contesting this decision and demands kuttikanam on all trees of the above species which are removed, irrespective of their size. The dispute has arisen through an error on the part of the Forest department. In paying stump fees

in respect of thinnings in this block in 1923–24, all teak 'logs' (as distinct from the various classes of 'poles') were taken into account, whether they were above or below three borrels. When the error was discovered the lessor was directed to refund a sum of Rs. 1,911 on account of logs under three borrels, but he refuses to do so. Further, he demands kuttikanam on trees below three borrels which were removed in the subsequent thinnings of 1924–25, and threatens legal proceedings. The matter is under correspondence with the Collector of Malabar. Inasmuch as the Government's imposition of a size limit is not stated in the karar, the lessor appears to have a strong case. At the same time he has accepted Government's ruling without protest until the year 1923–24. If it is decided that Government's attitude can be legally upheld, the Wandur Nambudripad must be sued for recovery of the excess payment, and in any case the karar should be revised in more definite terms.

(*b*) *Notification under section* 25 *of the Madras Forest Act.*—The Chatomborai block was notified as a reserved forest under section 25 of the Madras Forest Act V of 1882, in notification No. 757, dated 25th June 1885.

(*c*) *Total payments and cost value of land in* 1871–72.—The total amount disbursed under this lease, up to and inclusive of 1917–18 was Rs. 5,421. Allowing for an annual kuttikanam of Rs. 10, with a rent of Rs. 20,000 every 70 years in respect of final fellings, Mr. Bourne calculated the present value in 1871–72 of all sums paid and estimated to be paid in future to be Rs. 6,741, or Rs. 10·371 per acre. In December 1924 a sum of Rs. 2,703 was disbursed, but, as has been stated, Government has demanded a refund of Rs. 1,911 out of this sum. Until the matter is settled Mr. Bourne's figure of Rs. 10·371 per acre may be taken as the approximate cost value of the land in 1871–72.

51. *Summary.*—The present leases, covering the above forests, are, to all intents and purposes, perpetual leases, more or less free of rights. But it is unsatisfactory that, though Government has held most of the forests for upwards of 80 years, in only one of the leases (that with the Zamorin) is Government's liability indisputably determined. It is to be hoped that all controversial points will be settled in the near future and that the arrangements will be intelligibly revised where necessary.

B.—Forests in the absolute possession of the State.—

52. "*Purchased from Edavanna kovilagam.*—The Karumpoya and Old Amarampalam blocks, the latter of which contained a young teak plantation of approximately 87 acres, were leased by Government on the 20th April 1872 from the Edavanna kovilagam, free of all rights, except right of maintenance and access to temples, right of way, and rights to drag and store timber through specified dragpaths and in specified depots. In return, Government assigned to the kovilagam Rs. 80,000 and were to pay Rs. 100 annually as jenmabhogam.

(*a*) *Notification under section* 25 *of. the Madras Forest Act.*—These two blocks were notified as reserved forest under section 25 of the Madras Forest Act V of 1882 in 1884 (vide Notification No. 225, dated 15th February 1884). The sale of the jenm title of these two blocks was ordered by a decree of the Calicut Sub-Court in 1891, and their title was purchased by Government at a cost of Rs. 2,501.

(*b*) *Total payments and cost of value of land in* 1872–73.—The total amount disbursed under this lease up to 1891, and on account of the purchase of the jenm title, is Rs. 84,301. The present value in 1872–73 of all sums paid in respect of this area, or 4,511·5 acres, amounts to Rs. 82,583, or Rs. 18·305 per acre. Rupees 18·305 per acre is, therefore, the cost value of the land in 1872–73.

53. *Also purchased from Edavanna kovilagam.*—The New Amarampalam block was purchased by Government in public auction on the 19th December 1887 from the Edavanna kovilagam, and confirmed by the Court on the 20th February 1888, for Rs. 42,000. Occupancy rights were claimed subsequently over the Talikolli lands and were acquired on 2nd November 1896, on payment of Rs. 4,821-13-8 as compensation for improvements. The total amount disbursed on the acquisition of this block is, therefore, Rs. 46,821-13-8.

(*a*) *Cost value of land in* 1887–88.—The present value in 1887–88 of all sums paid in respect of this area or 61,744 acres, amounts to Rs. 45,538 or Rs. 0·738 per acre. Rupee 0·738 per acre is, therefore, the cost value of the land in 1887–88.

(*b*) *Notification under section* 16 *of the Madras Forest Act.*—This block was notified as a reserved forest, free of all rights, except rights of way and of drag-paths for timber, under section 16 of the Madras Forest Act V of 1882 (vide Notification No. 466, dated 25th October 1898)." [R. Bourne.]

(*c*) *Disreservation under section* 24 *of the Madras Forest Act.*—In 1926, 125 acres (chiefly swamp) of the New Amarampalam Reserve were notified as ceasing to be reserved forest, under section 24 of the Madras Forest Act V of 1882, in Notification No. 411, dated 10th December 1926. The area of the reserve is now, therefore, 61,619 acres.

54. " *Closing of all forests in the division to grazing.*—On 2nd July 1911, a notification was issued under section 26(*e*) of the Madras Forest Act V of 1882 closing all the forests in the south Malabar Division to grazing (vide B.P. Forest No. 155, dated 20th June 1911.)" (R. Bourne.)

Section 9—Profits and Concessions.

55. " *Rights.*—All the rights enjoyed in the leased and State forests, covered by this working plan, except rights of lessors to the payment of kuttikanam, are rights of way and rights of dragging and floating timber. They have been tabulated in one statement and recorded in the District Forest Office.

56. *Concessions.*—Where no specific rights have been admitted, the following concessions are allowed to the tenants of lands adjacent to or included in the leased forests, which lands are the jenm property of the lessors of such forests :—

(i) To pass and to take their agricultural cattle through the Government forests, for purposes of entry and re-entry upon their lands.

(ii) To cut and clear the undergrowth, for a strip 12 feet in width, adjacent to cultivated lands. Also to cut and remove all branches of trees and other growth which overhang their crops. The previous approval of the District Forest Officer has to be obtained in such cases.

A concessional payment of cloth, rice and spirit to the value of Rs. 5 is paid to the jenmacar or headman of the Shola Naickens, a small jungle tribe, whose home is the New Amarampalam reserve, on the capture of any elephant in the reserve. No other concessions are allowed, except upon the execution of an agreement and the deposit of a security—for instance, to timber contractors, for taking men and elephants along the river banks, etc." (R. Bourne.)

CHAPTER II—THE FOREST.

Section 1—Composition and Condition of the Crop.

57. " *Types of forest.*—From the description of the configuration of the ground, of the constitution of the soil, of the effect of the former upon the latter, and of the climate, which have already been given, it is hoped that it will not be difficult for the reader to realise that more than one type of forest must be found in the areas under this working plan. In fact, there are several distinct types. The primary division into types is based upon the differences in elevation. The forests on the ghats above 3,000 feet are entirely evergreen. On north-western and northern aspects they are generally met with at 2,500 feet, and on north-eastern aspects even down to 1,500 feet. Below these elevations, on the ghats and throughout the plains, the virgin timber forests are typically semi-deciduous, with this one exception, that along the river banks, in some places, there are very narrow belts of forest comprising a number of evergreen species. The majority of such species do not, however, occur in the evergreen forests of the ghats." [R. Bourne.]

A. Evergreen Forests on the Ghats.

58. *General.*—The evergreen forests of the ghats are by no means homogeneous. Both the species and the size of the trees vary considerably according to the elevation and aspect. The working of these forests is not prescribed in this working plan, so a very brief description of their contents will suffice.

59. "*Above* 6,000 *feet.*—Above 6,000 feet elevation these forests are typically stunted in growth, such species as Rhododendron arboreum and Eugenia sp. being the most common.

60. *Five thousand feet.*—6,000 *feet*—From 5,000 feet—6,000 feet elevation the forest is still small, mostly Eugenia sp. with a small bamboo with whorled branchlets, probably Oxytenanthera thwaitesii.

61. *Four thousand feet*—5,000 *feet.*—From 4,000—5,000 feet elevation the trees of a much larger type, up to 100 feet or more in height, more particularly on northern aspects. The commonest species are Mesua ferrea, Dichopsis elliptica, Cinnamomum sp. Diospyros sp. and Eugenia sp. The bamboo Teinostachyum wightii is found more or less throughout this belt. Gregarious patches of another bamboo, probably Ochlandra beddomei, also occur.

62. *Below* 4,000 *feet.*—The finest evergreen forest is found below 4,000 feet; giant trees, 150 feet or more in height are common. The commonest species are undoubtedly Dichopsis elliptica, Cullenia excelsa, both with very fine, straight and cylindrical stems, and a Cinnamomum sp. with a characteristically fluted bole. Acres upon acres occur, stocked, almost exclusively with these three species. All age classes are represented. Their regeneration, in fact, is prolific. Fairly high up in this zone, the most valuable species is Calophyllum elatum, the poonspar tree. It seems to occur in more or less gregarious patches. In the new Amarampalam reserve, the writer knows of two such patches, one in Thalishola, in the north, and the other on Karimalai, in the south. In such an extensive area of evergreen forest many more such patches must occur. Scattered about below 4,000 feet, the other notable species are Michelia champaca, Melia composita, Xylopia parvifolia, Machilus macrantha, Cedrela toona, Dysoxylum malabaricum, Artocarpus hirsuta and Hopea parviflora. The last four are all species of considerable value; in fact the last three, together with poonspar, rank only second to teak and rosewood in the West Coast market. In this zone, gregarious patches of a bamboo, Ochlandra sp. are sometimes found.

63. *Their beauty.*—These evergreen forests of the ghats, particularly in the lower zones, are of great beauty. With the luxuriant growth and dark foliage, coupled with the presence of tree ferns and such palms as Calamus sp. Pinanga dicksonii and Arenga wightii, they fully come up to the high expectations of tropical forests so often held by many before arriving in this country."—*R. Bourne.*

B. Semi-deciduous Forests of the foot-hills.

64. "*General.*—The semi-deciduous forests on the lower slopes of the ghats are much more homogeneous, at least as to the distribution of species. Only two distinct types of forest need be recognised, the more or less pure bamboo forest, Bambusa arundinacea, and the mixed timber high forest. The bamboo is, however, scattered more or less throughout the latter as an underwood.

65. *Pure bamboo forest.*—Extensive areas of more or less pure bamboo forest are rarely found about 500 feet elevation Above this up to the limit of the semi-deciduous forest, there are characteristically gregarious patches of pure bamboo extending only over a few acres in each case. In comparison with the extent of the timber forest, such patches may, for all practical purposes, be ignored.

66. *Timber high forest*—The timber forest, except on stony ridges and on shallow soils, often found on the slopes with a southern aspect, is of very fine growth.

(*a*) *Species occurring.*—By far the commenest species in these forests, are Terminalia paniculata, Xylia xylocarpa and in the valleys, Stereospermum chelonoides. Other notable species are, Lagerstroemia microcarpa, Terminalia tomentosa and

belerica, Bombax malabaricum, Adina cordifolia, Tetrameles nudiflora, Anogeissus latifolia, Eugenia sp., Vateria indica, Canarium strictum, Acacia ferruginea, Pterocarpus marsupium, Dalbergia latifolia and Tectona grandis. The very large trees are specimens of Terminalia paniculata, tomentosa and belerica, Lagerstroemia microcarpa, Bombax malabaricum, Tetrameles nudiflora, Anogeissus latifolia and very rare specimens of Adina cordifolia, Dalbergia latifolia and Tectona grandis. The last two species, together with a large number of Terminalia tomentosa and Lagerstroemia microcarpa were cut and removed before these ghat forests, in the New Amarampalam reserve, came into the possession of Government There is, however, some very fine pole growth of these four species, particularly of Lagerstroemia microcarpa and Terminalia tomentosa."—*R. Bourne.*

(*b*) *Pole growth and seedlings regeneration.*—Taken altogether the seedling regeneration is very unsatisfactory, with the exception of one species, Xylia xylocarpa, which regenerates itself freely (wherever it occurs) provided the overhead canopy is fairly open. Of the other valuable species, rosewood regenerates itself well, but the number of mother trees is small. (Both these species also produce root-suckers readily.) Regeneration of Terminalia paniculata is extremely disappointing, considering the preponderance of this species in the crop, and the case of the other valuable species is very little better. As regards poles, the position is somewhat better, but, on the whole, the percentage of poles to large trees is much less than it ought to be. It is believed that the general paucity of regeneration is mainly attributable to weed-growth and to the fact that the majority of the species demand a considerable amount of light for the successful establishment of their regeneration. (An understorey of bamboo, where it occurs, is even more prejudicial than weed-growth to the regeneration of tree species.) It is also extremely probable that forest fires, prior to the reservation of the New Amarampalam block, account for the fact that pole growth is more in evidence than regeneration at the present day. Subsequent to reservation, fires have generally been rare. At times of bamboo flowering they have been more frequent, and where the canopy has been opened by the death of the bamboos, fires have sometimes resulted in good regeneration of such species as Lagerstroemia microcarpa, Terminalia paniculata and tomentosa, Tetrameles nudiflora, Bombax malabaricum, Adina cordifolia, etc. This description will suffice for these forests, as apart from the semi deciduous forests of the plains. In fact it is difficult, for purposes of description, to draw a definite line between the two. The semi-deciduous forests of the lower foothills (except for the absence of the swampy type of vegetation) are very similar to many of the plains forests in their vicinity, for they have been subjected to the same treatment in the past. The description of the plains forests must therefore be understood to apply, in some respects, to parts of the forests of the foothills.

67. "*Predominant factors of locality affecting growth and the distribution of species.*—It seems more or less certain that in the ghats forest, whether evergreen or semi-deciduous, the size or quality of the resultant growth is mainly dependent upon the depth of the soil and the aspect, of which the latter factor, upon such steep slopes, has a natural tendency to affect the former.

Turning to the plains' forests, the depth, the degree of drainage of the soil, and their combined effect upon its physical properties, are the principal factors which not only affect the quality of the resultant growth, but even limit the distribution both of species and of the main types of forest. If this statement be taken as a rule, there are, of course, many exceptions, which, however, go to prove it. This will, it is hoped, be clear when the description of these forests has been given." —*R. Bourne.*

C. Semi-deciduous forests of the plains.

68. *General.*—The plains forests are of two distinct types—the irregular mixed natural forests and the evenaged forests of artificial origin. "Large areas have been cleared and planted with teak, but, as has already been stated, the conditions prevailing in certain areas were totally unsuited to the cultivation of that species and nature has retaliated for man's interference by killing out the teak, leaving such areas either blank or stocked with inferior species."—*R. Bourne.* The artificial introduction of crops of species other than teak has been attempted at various

times. Such attempts have usually been on a small scale, and have, with a few exceptions, met with indifferent success. So small are the areas in which other species have been raised successfully that it would be incorrect to describe them as a type of the plains forests. They will be described in the chapter which deals with past management, and the general description of the forests of the plains will be restricted to the areas planted with teak (successfully and unsuccessfully) and to the irregular natural forests.

(i) *Areas planted with teak.*

69. *General.*—Since they are more important than the mixed forests, the teak plantations, and the conditions prevailing in them, will be described first. (Many of the conditions are common to both.) Practically all age classes are represented, from 1—76 years. The only missing age classes are 43—51, 33, and 13—15. (Planting was stopped from 1877 to 1886, and again from 1913 to 1916, and no plantations were formed in the year 1895 while Mr. Lushington was engaged on his first working plan.) In addition there are a few plantations over 76 years old, which have been retained for various reasons; they are of ages 79, 82, 84 and 85 years. With the exception of a small second rotation plantation in the Ramalur block, all the plantations raised between the years 1843 and 1912 have been on clearings in virgin forest. In 1916 the final felling of the old plantations commenced, and from 1917 onwards about half of the teak planting undertaken has been on the sites from which the first rotation teak crops have been removed. No general description can convey a correct picture of the teak plantations to the reader who is unacquainted with them. Young, fully-stocked woods, which are growing rapidly, are an impressive sight, but one's first impression of the older plantations is usually that of disappointment. As a rule the canopy is open, the crowns are small, the boles are spoilt by epicormic branches, and fluted trunks are common. But the value o the plantations is enormous, as will be realized from the records of past yield and the yield tables. Further, the faults mentioned above can largely be avoided in future plantations under more enlightened management (especially as regards the execution of thinnings). The system of planting has mostly been in square spacing, $6\frac{1}{2}' \times 6\frac{1}{2}'$, $6' \times 6'$ and $8' \times 8'$. Teak has been planted pure, in almost all cases. In a few instances other species have been planted in mixture with the teak, but no such mixture has succeeded; either the teak or the other species has been suppressed in every case.

70. "*Appearance of other species naturally.*—Nature has, however, in many places, introduced other species in mixture with the teak, more particularly in areas unsuited to teak. In many such cases, there are few, if any, teak on the ground now. Reference is made here solely to cases in which the crowns of other species are in or above the upper canopy. The occurrence of undergrowth or of underwoods is referred to later. The principal species to be noted as occurring in mixture with the teak are Xylia xylocarpa, Terminalia paniculata and tomentosa, Dalbergia latifolia, Lagerstroemia microcarpa and Flos-Reginae, Tetrameles nudiflora and the bamboo, Bambusa arundinacea.

(*a*) *Xylia xylocarpa.*—Xylia xylocarpa occurs on most laterite soils, particularly wherever the laterite rock is anywhere near the surface. In such cases it is occasionally found in even mixture, but more generally dominating, or suppressing and even killing out the teak. There are many instances of more or less pure and evenaged woods of Xylia xylocarpa to be found in areas originally planted with teak. Xylia xylocarpa is rarely found on alluvial soils.

(*b*) *Terminalia paniculata.*—Terminalia paniculata is often found scattered among the teak on the hillocks, particularly with Xylia xylocarpa on shallow soils unsuitable to teak. It is occasionally found in mixture with the teak, on alluvial soils, and often found on the edges of rather swampy localities.

(*c*) *Terminalia tomentosa.*—Terminalia tomentosa is often found, in mixture with the teak, on the edges of swampy localities, in which it thrives. Such growth, however, is generally very open, the poor growth or extinction of the teak being due to the locality rather than to suppression. A few examples of very fine growth of this species are to be found on well-drained alluvial soils, on which it, by no means, takes second place to teak in respect of rate of growth.

(*d*) *Dalbergia latifolia.*—Dalbergia latifolia is found in mixture with the teak under various conditions. There are a few instances on alluvial soils, in good quality teak locality, but, from the dominant character of the trees, and from the records, it is certain that they existed on the ground in the pole or sapling stage, when the area was cleared. There are similar instances on disintegrated gneiss and laterite soils, to which the same remarks refer. There are, however, further instances on such soils, in which the rosewood is growing up through the crowns of the teak. On laterite soils the rosewood, scattered more or less throughout with Xylia xylocarpa and Terminalia paniculata, is replacing the teak.

(*e*) *Lagerstroemia microcarpa.*—Lagerstroemia microcarpa is often found in mixture with the teak on alluvial soils, both good and badly drained, though it does not occur in bad swamps, which it avoid salmost as much as does the teak. There are some very fine examples of its regeneration in the young teak plantations. Its rate of growth on good teak areas is as fast and faster than teak. There are some examples of it in mixture with teak on disintegrated gneiss and frequently on laterite soils.

(*f*) *Lagerstroemia Flos-Reginae.*—Lagerstroemia Flos-Reginae is found occasionally in mixture with teak on very low-lying alluvial soils on river and stream banks, but in the majority of cases in which it occurs on such areas, it has replaced the teak, forming more or less pure woods. It is also found along the edges of bad swamps, and scattered regeneration of this species is appearing even in the middle of such.

(*g*) *Tetrameles nudiflora.*—Tetrameles nudiflora is found in a few instances, in mixture with the teak, on well-drained alluvial soils, more especially in the young plantations. Its rate of growth, in the very best teak quality of locality, far surpasses that of teak.

(*h*) *Bambusa arundinacea.*—Full-grown clumps of Bambusa arundinacea are found scattered throughout. They do not interfere or break the teak canopy except in poor II and III quality localities, and in areas unsuited to teak, especially swamps. In the latter areas they have often replaced the teak."

71. *Appearance of these species in pure teak woods attracts attention and affords an excellent opportunity for studying their silvicultural requirements.*—In the foregoing remarks the writer does not wish to give the impression that instances of the admixture of other species are seen everywhere. The impression of a visitor to the plantations would be that, with the exception of areas really unsuited to the teak, the remaining areas were absolutely pure. For all intents and purposes, such an impression would be correct. The area covered by instances of other species in mixture with teak, otherwise than in localities unsuited to it, is infinitesimal compared with the area of pure teak. His object in describing such instances of admixture in some detail is manifold. It should suffice if one is pointed out. For instance they afford very valuable evidence not only as to the sites suitable for such species, but also as to the quality of growth that may be expected on each. In an extensive pure forest, such instances immediately attract attention and in this particular case, since, with few exceptions, the trees of these species are at least not older than the teak, their rate of growth can at once roughly be compared with a measured standard. This is not the case in a mixed irregular forest.

72. "*Quality of teak growth and the predominant factors of locality affecting the same.*—In the more or less pure teak areas, the quality of the growth is very divergent. The two extremes are found in absolutely distinct localities. The very best on deep alluvial soil with perfect drainage of the surface-soil and sub-soil, and the very worst both on laterite soil, where the laterite rock outcrops, and under pronounced swampy conditions. Between these two extremes, every conceivable quality of growth is to be found.

(*a*) *The very best growth on river alluvium.*—The extent of the very best growth is distinctly limited. It is confined to more or less long narrow strips along the river banks, or to small patches ranging from a few trees, up to 2 or 3 acres. What the factors are which cause this difference between the very best and the very good growth, both on well-drained alluvial soils, is somewhat doubtful.

(*b*) *Optimum depth of river alluvium.*—There would seem to be one main factor, the result of the very high river banks and of the comparatively low power of the river alluvium to retain moisture. This factor is the depth below the surface, in river alluvium adjacent to the river bank, of the water level during the months immediately succeeding the end of the south-west monsoon and the consequent rapid fall in the river water level. There is, in fact, an optimum depth of river alluvium for the growth of teak.

(*c*) *Low-lying shallow alluvial soils.*—If the depth of alluvium is too far below this optimum, the soil is saturated with water for several months in the growing season, resulting in bad soil aeration, the failure of the teak and appearance of such species as Lagerstroemia Flos-Reginae, Trewia nudiflora and bamboo.

(*d*) *Effect of optimum depth upon the length of the growing season.*—A phenomenon which is distinctly noticeable in areas in which the depth of soil approaches the optimum is the long retention of the foliage by the teak, at least a month longer than on deeper, though well-drained alluvial soils. During the latter months of the growing season, the teak roots obtain their water, not only from the moisture contained in the upper layers of the soil, but also from the much moister layers nearer the main water level.

(*e*) *Alluvial soils of depth greater than the optimum.*—If the depth of the alluvium is much greater than the optimum, the teak roots do not reach down to the moist layers of soil directly above the main water level, and have thus to content themselves with only a moderate quantity of water, which necessitates the fairly early closing of the trees growing season.

(*f*) *Proximity to river bank is not a criterion of good growth.*—The mere proximity to the river bank on river alluvium is by no means a criterion of good growth. The actual bank of the river bed may be comparatively low, in which case there may be a strip or shelf of more or less level ground, generally very narrow, followed by a sharp rise to the main level of the alluvial land. This formation, according to the height of the shelf above the river bed, accounts either for the failure of the teak or for the growth of the very best teak to be found. Again the actual bank of the river bed may be comparatively low, from the top of which the ground slopes directly up to the main level of the alluvial land. Such narrow strips may, if the actual bank is not too high, show the very best growth of teak. Finally a phenomenon, which is common in alluvial lands, is that the actual river bank is somewhat higher than the adjacent land. Provided there is sufficient surface drainage towards a secondary drainage system, inferior growth may be found on the river bank, and the very best growth on the lower ground a little further back. In all these cases, there is little doubt that the depth, below the surface, of the water level during the months succeeding the monsoon is the main factor affecting the growth. It is possible, however, that organic compounds formed on the higher lying ground, washed down and deposited on the lower ground, improve the fertility of the latter.

(*g*) *Very good growth on deep disintegrated gneiss soils.*—In addition to well-drained river alluvium, very good growth is found on the few instances of deep disintegrated gneiss. Such growth is only second to the very best, located as described above.

(*h*) *Distribution of inferior qualities of growth depends mainly upon depth and drainage of the soil.*—The distribution of the more inferior qualities of growth depends primarily upon the configuration of the ground, and its effect upon the depth and drainage of the soil.

(*j*) *Effect of aspect on quality.*—On the hillocks, the aspect also has appreciable effect upon the growth, both indirectly through its effect upon the soil and the processes of disintegration, and directly through its effect upon the physiological processes of transpiration, whereby the teak tree on south-eastern, southern and south-western aspects shortens its growing season, as a precaution against excessive transpiration. The leaf fall occurs much earlier on the southern than on the northern sides of hillocks.

(*k*) *Generally better growth on disintegrated gneiss than on any laterite soils.*—These are the factors which appear to regulate the quality of the resultant growth in teak areas, except that a better growth is generally found on disintegrated gneiss

than on any laterite soils. In this connexion it may be noted that quite good growth is often found on well-drained laterite alluvium, but only when it forms a comparatively shallow layer, overlaying either disintegrated gneiss or river alluvium."—*R. Bourne.*

73. *Second rotation crops.*—As has been stated, the regular formation of second rotation teak plantations commenced in 1917, and since then about 700 acres of old plantations have been felled and replanted with teak. The results are most disappointing. There has been a general falling off in quality. Many of the new plantations are so extremely poor as to have no visible future, and there are large areas of absolute failure It has to be remembered, however, that in a number of the recent years, abnormal conditions have prevailed, and in order to investigate the situation, the plantations of these years should be left out of account. If this is done, the planting work of six years has to be disregarded for the following reasons: In 1918 funds were inadequate to allow of the timely clearing and burning of the planting site; the monsoon began before the middle of May; parts of the area had to be cleared by hand as burning was impossible; and planting was delayed till late in July. Tending of the 1921 plantations had to be abandoned in August owing to the outbreak of the Malabar rebellion. The result was practically a total failure. They were reformed in 1922, and previous experience has shown that a good plantation cannot be expected in such circumstances. The unprecedented floods of 1924 destroyed large areas of the plantations of that year (as well as some of previous years); the nurseries were destroyed and plants were not available for replacing casualties when the floods subsided. In the years 1926 and 1927 practically all the planting was done by cultivators in conjunction with field crops. This innovation was made without previous experiment. The result, in 1926, was nothing short of a tragedy, while in 1927 only about 50 per cent success was obtained. This leaves only five plantations for consideration, and they may be discussed in order of planting. The 1917 plantation is easily the best. It is on record that a fierce burn was obtained, the planting was done early and well, and the weedings were well executed. The plantation has been stock-mapped by the writer, and it has been found that a considerable part of it is II quality (though mostly low II quality). In such parts, therefore, it cannot be definitely stated that there is any deterioration, for the first rotation crop was also II quality, and may have been low II quality. In the parts which have sunk from II to III quality the drainage is somewhat indifferent. The hardening of the surface-soil, by exposure in the first rotation, would naturally intensify the defects of drainage, and the inferiority of a young teak crop under such conditions seems quite understandable. The weedings of the first and second year must have loosened the soil to some extent, but it is extremely hard now, and is constantly trampled by cattle from the neighbouring village. Parts of the 1919 and 1920 plantations (in Elenjeri) are on laterite soils which carried poor crops in the first rotation. Such parts have either failed or carry teak of miserable growth. Other parts (though not of great extent) were damaged by the floods of 1924. But there remain considerable areas in these plantations where the soil is deep alluvium and yet where the teak is very poor, and in some places, has the appearance of having ceased to grow. The first weeding in the 1919 plantation was delayed till September whereas it should have been done in July. Mr. Robinson records that, when the monsoon commenced, dragging, lining, pitting and planting were all in progress at the same time in the 1920 plantation. The above factors must account, to some extent, for the deterioration in quality, but it is also probable that there is some fault in the soil, though the crop could have been improved somewhat if climbers have been cut in the years succeeding the weedings. The plantations of 1923 (in Edacode) also seem to have been planted well, but here, also, the growth (on good soils which suffered little or no flood damage) is very backward and the quality is obviously lower than that of the first rotation. There are large areas of absolute failure on laterite soils. The 1925 plantations are reasonably good in parts, and would have been much better had the planting been done early in the monsoon, and the stocking completed in the year of formation. As it was, planting was delayed, on the questionable grounds that the nursery plants were too small, and there do not appear to have been enough plants for replacing casualties at the close of the season. As a result of the crop is very uneven, a large percentage of the

plants being those of 1926. Ploughing experiments in 1925, and digging of the soil in the following year, have helped the growth of this plantation considerably. Although large areas of the existing second rotation plantations have failed, and though most of the remainder are of miserable development, the situation, for future re-planting, is by no means hopeless. There is much need for experiment, and some special tending of the second rotation crops of the future will certainly be required. It is hoped that the correct treatment will be discovered within the next few years, and that good teak crops can still be raised on the sites of the old plantations, or at any rate on the sites of all except the worst of the old teak woods. Suggestions are made in this working plan.

74. *Underwoods and undergrowth — General description.*—It is common knowledge that pure crops of teak cannot preserve the quality of the soil, and this fact has recently been emphasised, at Nilambur, by the inferior growth of young crops of teak on the sites of the old plantations. Further, a pure teak crop cannot, after early youth, keep itself free of the epicormic branching which follows defoliation. The question of underwoods is therefore of the first importance. Throughout the plantations, with the exception of sites on river banks which are frequently used as timber depots, there is an undergrowth of some sort or other, whether open, scattered, or dense. But the position is far from satisfactory. Compared with the total area of the plantations, areas carrying a suitable underwood are of small extent. Most of the plantations over 30 years of age are characteristically deficient in underwoods, and this is more especially the case on alluvial soils. The undergrowth on such soils is often composed mainly of grass and annual weeds, which exhaust the soil and do little to protect it from exposure. Saplings and poles of tree species are often few and far between, and regeneration of tree species, though fairly common, does not usually seem able to cope with the weed growth which generally surrounds it. On the drier soils of the hillocks, the underwood is often sufficient; in fact it tends to establish itself in the upper canopy and to suppress the teak in the poorest teak localities. The younger plantations, as a rule, are better off, most of them having the soil protection of a mixed undergrowth, but annual weeds and short-lived deciduous shrubs are common. Such an undergrowth cannot, of course, prevent epicormic branches on the teak; it imposes a continual drain on the food-supply in the soil (partly because of its frequent flowering); and it often prevents the development of seedlings of forest trees, which, if they could come up, would make a satisfactory understorey. The underwood and undergrowth in each compartment have been fully described in the description of compartments. In dealing with the *undergrowth* the writer has included the regeneration of tree species and of bamboo wherever they are less than a man's height. It would probably be more correct to consider than as forming part of the *underwood*, but it is claimed that the system adopted will facilitate the study of the future development of the understorey.

75. *Reasons for the unsatisfactory condition of the underwood.*—For the present deficiency and unsuitability of the understorey there are a number of contributory causes, and the chief of them may now be enumerated:—

(i) From 1863 to 1906, all or most of the undergrowth in the plantations was annually or periodically cleared. From the latter date all such clearing was stopped, except in so far as it was necessary to free the teak, or to permit of entry into the plantations for the proper execution of works. Much of the deficiency of undergrowth in the older plantations is attributable to these repeated clearings.

(ii) The clean weeding in the first two or three years of a plantation's life has destroyed a lot of adventitious growth which, if preserved, would help to provide an understorey. Seedlings of tree species are removed with the weeds, and coppice shoots are continuously cut until the stools loose their power of reproduction. It is, admittedly, difficult to preserve small seedlings, but the same cannot be said of coppice growth. It may, however, be argued that coppice shoots of miscellaneous species would suppress the teak, and this is true of some species but not, by any means, of all. And in any case the tendency to suppress the teak can be easily checked without utterly destroying the aggressor. The wholesale retention of coppice growth is not, of course, recommended, but it is thought that some judicious selection of regrowth and regeneration of tree species is possible, and that it would help to solve the underwood problem.

(iii) The necessity of providing large supplies of cross-pieces for the timber rafts has resulted in the repeated and wholesale cutting of small poles of miscellaneous species, wherever they could be found in the neighbourhood of the rafting places. The pollards of such species as Trewia nudiflora and Strychnos Nux-vomica, which are so often seen near the rivers, bear eloquent testimony to the depredation that has taken place.

(iv) It has already been mentioned that the sites of river-side depots are devoid of undergrowth. The periodical dragging of timber to these depots must prevent, to some extent, the establishment of an underwood in their vicinity. Appreciable damage undoubtedly results from the presence of elephants in the plantations, when work is in progress. (This is unavoidable, but there is no excuse for establishing a rest-camp in the plantations.)

(v) In recent years the middle-aged and old plantations have been very heavily thinned, partly because the earlier thinnings had been so light that the crowns were unduly restricted, and partly with the idea that the trees left would respond vigorously and put on a greatly increased increment. The trees, however, having grown up in a congested condition, were unable to respond, the crowns have not expanded, and the growth of grass and weeds has been stimulated by the excessive opening of the canopy.

(vi) Of still more recent history is "the conflagration" of 1926. Further details will be given in discussing past management. It is sufficient, here, to state that practically all the plantations of 20 years old and upwards were departmentally fired in the middle of the hot weather of 1926. Practically no damage was done to the teak crops, but such understorey as had been able to establish itself during 20 years of careful preservation suffered severely in many places. The damage is only temporary, for re-growth of most of the burnt poles and saplings is appearing. And in some cases it appears that the regeneration of species such as Macaranga Roxburghii and Trewia nudiflora has been stimulated to some extent. But there is no doubt that the fires have caused a more luxuriant growth of grass and other undesirable weeds, in many places where the canopy is open, and that the growth of evergreen shrubs has had a setback in other places.

76. *Species occurring in the underwood and undergrowth.*—" The principal species to be noted in the plantations are Helicteres Isora, Randia dumetorum, Cleistanthus collinus, Strychnos Nux-vomica, Butea frondosa, Cassia Fistula, Holarrhena antidysenterica, Wrightia tinctoria, Pterospermum reticulatum, Careya arborea, Zizyphus xylopyrus, Glycosmis pentaphylla, Hydnocarpus Wightiana, Bauhinia sp., Clerodendron sp., Phyllanthus Emblica, Limonia acidissima, Macaranga Roxburghii, Trewia nudiflora, Lantana and regeneration of the species noted above, as growing in mixture with the teak in certain instances. The flowering of Bambusa arundinacea in different localities from 1910 onwards has produced, in many instances, a considerable admixture of bamboo regeneration. The composition of the undergrowth is very far from homogeneous.

(i) *On well-drained river alluvium.*—On well-drained river alluvium the commonest species are bamboo and bamboo regeneration, Trewia nudiflora, Strychnos, Nux-vomica, Glycosmis pentaphylla, Clerodendron sp., Helicteres Isora and Lantana.

(ii) *On indifferently drained river alluvium.*—On less well-drained river alluvium, the same species are found together with Randia dumetorum, Zizyphus xylopyrus, Butea frondosa, Careya arborea and regeneration of Lagerstroemia Flos-Reginae and Terminalia tomentosa.

(iii) *On laterite and disintegrated gneiss soils.*—On laterite and disintegrated gneiss soils, the commonest species are Helicteres Isora, Cleistanthus collinus, Phyllanthus Emblica, Macaranga Roxburghii, Randia dumetorum, Lantana with bamboos, bamboo and Xylia xylocarpa regeneration.

77. *Underwoods, distinguishable from undergrowth.*—The regeneration of some timber species also forms an underwood in some instances which may be differentiated from the irregular undergrowth of trees, shrubs, etc. There are, in fact, good examples of seven different species forming underwoods in teak areas.

(*a*) *Dalbergia latifolia and Terminalia tomentosa in small patches only.*—The examples of underwoods of two of these species, Dalbergia latifolia and Terminalia tomentosa, are confined to very small patches, the former on laterite and disintegrated gneiss and the latter on river alluvium.

(*b*) *Xylia xylocarpa.*—Of the other species, by far the commonest are examples of Xylia xylocarpa. On laterite soils, over quite large areas, there is a dense underwood of Xylia xylocarpa regeneration in all stages from seedlings to small trees. In a few instances, the growth is much more evenaged and has established itself on the ground to the practical exclusion of everything else. Provided the teak growth is of fair quality, this species remains as an underwood. Where the teak growth is poor, as already stated, this species tends to challenge the supremacy of the teak, and even to replace it.

(*c*) *Lagerstrœmia Flos-Reginæ.*—In low-lying localities, under rather swampy conditions, there are examples of the regeneration of Lagerstrœmia Flos-Reginæ forming an almost pure underwood. Dense regeneration of this species, however, does not seem to appear unless the canopy afforded by the teak is already very open on account of the bad aeration of the soil. This species does not challenge the supremacy of the teak or replace it, unless the teak growth is poor."—*R. Bourne.*

(*d*) *Bambusa arundinacea.*—There are good examples of bamboo forming a suitable underwood in a number of places in the plantations. Full-grown clumps are found, but it is more usual to see the bamboo as straggling regeneration, or (in a few places) as a dense thicket. The bamboo flowered between the years 1910 and 1919, and the results should be more obvious in the near future, when the various stages of regeneration have had a chance to grow up. Though individual culms grow to a length of even 100 feet, the average height of full-sized clumps in the teak plantations is not more than 70 feet. In the older teak areas of good quality, the bamboo does not challenge the supremacy of the teak. In young plantations, and in poor teak areas, the bamboo overtops the teak and suppresses it, if not kept in check. Mr. Bourne considered Bambusa arundinacea to be the most suitable underwood for the older teak plantations of good growth, and be sowed seeds over large areas in suitable localities (though with little apparent success). Several officers share this view, and the writer agrees with them. He is not convinced, however, that this bamboo would form a natural underwood, or could be raised artificially as an underwood, *if the plantations were fully stocked with teak trees of the best type.* The older plantations of the present day are generally too open, and the crowns are small. But correct management must aim at a complete canopy of large crowns, and, when this desirable condition can be obtained it is extremely doubtful whether the local indigenous bamboo can survive at all except as a straggling undergrowth.

(*e*) *Hopea parviflora.*—There are a few instances of the natural regeneration of Hopea parviflora forming an underwood in teak plantations. Such instances, with one exception, are of very small extent. In Edacode, compartment 83, however, 5 or more acres contain a good underwood of this species. The underwood is very dense in places. Part of the area is alluvium, and part disintegrated laterite with outcrops of gneiss. The growth on the laterite is denser and better than that on the alluvium. This natural regeneration has come from four mother trees on the river bank. It is on record that in 1904 there was a dense carpet of Hopea seedlings. The best poles are now about 60 feet high, and all stages are found, down to small seedlings.

(*f*) *Swietenia macrophylla.*—In many places where the broad-leaved mahogany was planted among the teak, natural regeneration of that species is to be found beneath, and in the immediate vicinity of the parent trees. Such regeneration is usually scattered, but prior to the fire of 1926 there was a dense pure underwood of mahogany regeneration in a teak plantation in Pannengode, the best growth being as much as 40 feet in height. Most of it was killed by the fire.

78. *Underwoods introduced artificially.*—Spasmodic efforts have been made in the past, on an experimental scale, to introduce underwoods artificially, but it is only in recent years that this question has received serious consideration. There is little to show up to the present, and research is still proceeding. The species tried, and methods adopted, are described in Chapter V.

(ii) *Natural forests.*

79. *General.*—As in the case of the growth found in planted areas so with the natural forests of the plains, the influence of locality is the principal factor governing the distribution of species. There is a second factor, however, which has had a very considerable effect. Some of the forests, though they have been in the possession of Government for a long time, and have been protected with considerable success, have been fairly heavily felled over for the extraction of timber from time to time. The remaining forests, which only came into the possession of Government in more recent years, had already been depleted, to a great extent, of the most valuable timbers such as teak and rosewood, and, to a lesser extent, of Terminalia tomentosa, Lagerstrœmia microcarpa and Xylia xylocarpa. There is no doubt that many of the gaps, resulting from these fellings, have been stocked, at the time of periodical flowering, with Bambusa arundinacea. The preponderance, in many places, of Terminalia paniculata in the upper storey, is due, in part, to the renewal of the other species mentioned above ; and Xylia xylocarpa, which regenerates itself more easily than any of the other timber species, must have received considerable assistance from such opening of the canopy.

80. *Distribution of bamboo.*—Bambusa arundinacea is very widely distributed in the timber forests of the plains, either in mixture or as an underwood. In the very best timber forests, however, it is scarce, except in more open patches. Though its seeds germinate under fairly heavy shade, the regeneration appears to remain as a scattered undergrowth under such conditions. Bamboo is found in great abundance in any open forest, where it takes its place in the canopy, or grows in the second storey, according to the height of the forest. There is no doubt that at each flowering the bamboo spreads to a considerable extent. Its subsequent development depends on the conditions of space and light which it finds. At the present time there are large areas of pure bamboo, or bamboo forest with a small mixture of timber trees. In many places it forms a dense underwood to the more open timber forests of good type. In the less open timber forests it is very common as an undergrowth, up to 10 feet in height, its density depending on the density of the canopy. It is scarce, or absent, only in the best irregular timber forests, in poorer forests where the shade is heavy (e.g., almost pure woods of dense Xylia xylocarpa) and in areas which are well stocked with good pole growth, either with or without some mixture of larger trees.

81. *Effect of bamboo upon the distribution both of types of forest and of species.*—Wherever the bamboo occurs in any density, it has a marked effect on the regeneration of timber species, especially in the case of strong light demanders. Few tree seedlings can survive under a dense bamboo thicket. No regeneration of timber species can compete with that of the bamboo, given an equal start, and a considerable amount of light. Finally, in places where the shade is fairly dense and, where scattered bamboo regeneration is found in company with light-demanding tree seedlings, the bamboo is practically certain to win when the light, which both are awaiting, is admitted. This, on the face of it, is a gloomy picture, and the reader is entitled to enquire how it happens that there is any timber at all in many of the forests. The fires of the past are the only answer that the writer can suggest. Since reservation, though fires (especially during bamboo flowering) have often been unavoidable, there has been far less burning than when the forests were privately owned, and it is confidently stated that fire protection has helped the bamboo, at the expense of the timber species. The general deficiency of tree seedlings, combined with the presence of poles and large trees in the New Amarampalam reserve (purchased in 1887) and the frequent absence of practically all tree growth except the largest, in many parts of the blocks which have been longest in the possession of Government, appear to confirm this theory.

82. *Five-storeyed high forest.*—" The best timber forest is found on fairly drained river alluvium or on deep disintegrated gneiss. Such forests contain five distinct storeys. There are giant trees up to 150 feet or more in height of such species as Terminalia paniculata, Terminalia tomentosa, Lagerstrœmia microcarpa, Terminalia belerica, Anogeissus latifolia, Ficus sp., Adina cordifolia, Bombax Malabaricum and Tetrameles nudiflora. Then there are middle sized to large trees of the above species, together with such as Stereospermum chelonoides, Dillenia pentagyna, Strychnos

nux-vomica, Schleichera trijuga, Hydrocarpus Wightiana, Machilus macrantha, Vatica Roxburghiana, Vateria Indica, Canarium strictum, Eugenia sp., Trewia nudiflora, Sterculia sp., Grewia tiliæfolia, Pterocarpus marsupium, Alstonia scholaris, Acacia ferruginea, Stereospermum xylocarpum and a few trees of Xylia xylocarpa, Dalbergia latifolia and teak. Of all these species Terminalia paniculata forms nearly one-half, and in some places more, of the crop.

Then there is the pole growth of the above species, particularly of Lagerstrœmia microcarpa, Terminalia tomentosa and paniculata, Bombax Malabaricum, Tetrameles nudiflora, Stereospermum chelonides, Dalbergia latifolia, and here and there of teak. This pole growth is most distinct in open patches, where giant trees have fallen, and in localities in which there is a large proportion of giant trees and the upper canopy is, in consequence, at a great height and rather open. Poles of Lagerstrœmia microcarpa are the most common. Clumps of Bambusa arundinacea are scattered throughout this type of forest. Then there is the undergrowth of small trees and shrubs, such as Cleistanthus collinus, Wrightia tinctoria, Holarrhena antidysenterica, Cassia fistula and Helicteres isora. Finally there is invariably a layer of herbs and grass, which, however, is not so dense as to prevent the free access of seed to the ground.

83. *Four-storeyed high forest.*—A medium sized timber forest is found on disintegrated laterite and gneiss soils, wherever the depth and drainage are sufficient. In the areas further from the ghats, where the laterite predominates, the growth is smaller than in localities closer to the ghats where the laterite begins to disappear. The forest is typically four-storeyed, with more or less the same species as occur in the large timber forests already described. The chief differences lie in the absence of the giant trees, a much denser stocking of bamboo as an underwood, and the universal distribution of Xylia xylocarpa. Moreover, on the laterite areas, such species as Terminalia belerica, Anogeissus latifolia, Tetrameles nudiflora, Adina cordifolia and Trewia nudiflora disappear. The outstanding feature of these forests on laterite is the very high proportion sometimes of Terminalia paniculata, sometimes of Xylia xylocarpa and often of both these species, in the growing stock."—*R. Bourne.* The regeneration in these forests is very poor, and is chiefly confined to the more open patches where bamboo is absent. The scarcity of regeneration is almost certainly attributable to the light requirements of practically all the tree species, and to the presence of either bamboo or weed growth.

84. *Three-storeyed high forest.*—Without a thorough mapping of the forests it is impossible to estimate the extent of the three-storeyed type, since it is usually confined to scattered areas of limited acreage. There are two subdivisions of this type. One is found on sloping ground where the soil is moderately deep. The overwood consists of tall mature trees of Terminalia paniculata, with an understorey of good poles of Xylia xylocarpa. The lowest storey is the soil-covering of shrubs and Xylia regeneration. The best example of this kind of forest is near Narakadavu in the Amarampalam Range. The second kind of forest of the three-storeyed type is probably more common than the first. It is found on more or less level ground, often in semi-swampy localities. The topmost storey consists of large trees of such species as Terminalia paniculata and tomentosa with occasional specimens of Lagerstrœmia microcarpa, Tetrameles nudiflora, Dillenia pentagyna, etc. The second storey is made up of good pole growth (often dense) of Terminalias, with scattered specimens of other good species such as Lagerstrœmia microcarpa and rosewood, and often a moderate percentage of inferior species like Cleistanthus collinus. The soil covering is seldom dense, and consists chiefly of shrubs. The density of the overwood varies enormously, and the pole-growth varies accordingly, but in inverse proportion. In the best examples of this type of forest, large trees are scarce or lacking, and the woods are more or less evenaged pole crops.

85. *Two-storeyed high forest.*—The true two-storeyed type is not very common in Government forests, except in areas originally cleared and planted with teak. The crop is more or less evenaged, and consists almost entirely of Xylia xylocarpa. The understorey is the low soil covering of shrubs and Xylia regeneration. But there are considerable areas in many of the forests in the Nilambur Range, and in parts of the Nellicutta block of the Amarampalam Range, where timber species are

practically confined to the overwood, and where poles and regeneration (except of useless species) are so scanty as to be of little account. The presence of bamboo in this kind of forest depends on the prevailing conditions of space and light.

86. *Swampy timber forest.*—A fifth type of timber forest is found in swampy localities. "The forest is characteristically irregular and generally open in appearance. The principal species is Terminalia tomentosa, with some Terminalia paniculata and a little Lagerstrœmia microcarpa, and with such secondary species as Dillenia pentagyna, Careya arborea, Randia dumetorum, Zizyphus xylopyrus, Butea frondosa and Phyllanthus emblica. There is also generally a considerable admixture of bamboo. In every marshy localities, particularly in open forest, Lagerstrœmia Flos-Reginæ is common."—*R. Bourne.* On the edges of the wettest parts of this type of forest, and sometimes on ground which is very slightly raised above the middle of a swamp, it is very common to find teak, trees and poles of quite and good growth. In fact natural teak, in the plains forests, is more common in ill-drained to semi-swampy localities than elsewhere. Its presence enhances the value of such localities, and it should be assisted by climber-cutting, etc. But such areas should on no account be felled and planted with teak, for they are certain to become too swampy for the existence of pure teak crops.

87. *Grass swamp.*—The open swampy timber forest merges, in the wettest localities, into open grass swamps, and there are considerable areas of grass lands of this type. Often they are not too marshy to support trees such as Terminalia tomentosa, Butea frondosa, etc., and such species may be found scattered. But these lands are the grazing grounds of deer and bison, and as such there is little chance of their natural afforestation. If labour can be persuaded to live in the forests, there are ample lands, suitable for paddy cultivation, on which they could settle.

88. *Types of forest found here and there along river banks.*—"Finally, a distinct type of forest is often found along the river banks, composed generally of such species as Trewia nudiflora, Tetrameles nudiflora, Gmelina arborea, Vitex altissima, Eugenia sp., Ficus sp., Machilus macrantha, Artocarpus hirsuta and sometimes Hopea parviflora."—*R. Bourne.*

Section 2.—Injuries to which the Crop is liable.

89. "*Wind.*—Damage by ordinary winds is not serious. In the natural forests, old trees are to be seen top-broken or blown over. In the teak plantations, a few trees are annually top-broken or blown down. Edges of old woods which have suddenly been exposed by clear-fellings, have not suffered from wind. In executing fellings the prevailing wind direction need not be taken into account. Violent storms, however, occur annually from April to June. The majority of the windfalls and crown breakages occur at these times. With these storms, whirlwinds are experienced every now and then. The course of these whirlwinds can be tracked, often for considerable distances. They generally follow the course of the rivers. The main river is from 50—100 yards broad and runs between high banks, 20′—50′ above the river bed. Given high forest on each bank, at least 100′ in the height, the river forms a hollow which tends to divert the original direction of the gale. Pockets and eddies are formed, the air shooting down 100′—150′ to the river bed and then being forced up on the other side. If one stands on the river bank or in the river bed the direction of the gale never seems to be the same for two consecutive minutes. The whirlwinds probably originate under these conditions. The track of a whirlwind invariably commences from a river bank and returns thereto. In its course, here and there, first one side and then the other, a tree is uprooted or broken in half, the crown being dropped 10′ to 20′ away. Fortunately bad whirlwinds are not common. The result of two in the plantation area has been seen within recent years. One of these passed partly over an older wood, over fifty years, and partly over a younger wood, under thirty. In the older wood only trees with restricted crowns were broken; in the younger wood, which was very crowded and badly in need of thinning, the damage was very serious—more than half the trees being broken.

The records refer to seven violent storms between 1859 and 1905—

(i) On the 12th July 1859. 1,663 teak trees were broken and 243 uprooted in the oldest plantation, Aravallikava 1843.

(ii) In May 1862. Considerable damage was caused in plantation, Aravallikava 1844.

(iii) In August 1878. Especial damage was caused in plantations, 1861—69, 1873 and 1874 of Old Amarampalam.

(iv) In May 1879. Considerable damage was caused in plantation, Aravallikava 1844.

(v) In November 1881. The principal damage was caused in the plantations 1844—18 of Edacode.

(vi) In August 1884. Considerable damage in the plantations of Aravallikava.

(vii) On the 17th October 1898. A whirlwind broke and uprooted a large number of poles along a definite track through the plantations 1886 and 1887 of Pannengode.

The very local effect of these storms would indicate that they were probably all caused by whirlwinds such as those experienced in 1898 and recently in 1913. The latter broke and uprooted a large number of trees and poles in plantations 1863, 1886 and 1887 of Pannengode. The recurrence of damage in the vicinities of Aravallikava 1844 and Pannengode 1886 is probably not attributable to the opening of the canopy on previous occasions. In Pannengode, for instance, the damage done in 1913 was in a very congested portion of the crop. On the 12th May 1918, the writer was out in the young plantations of Karumpoya when a short but violent gale occurred, which prove to be the preliminary of steady downpour of the South-west monsoon. Poles here and there were broken by wind. The severest damage occurred in a part of the plantation of 1901, which had just been severely thinned. Practically unthinned previously, though of good quality, the crop had been extremely congested and the poles in consequence were very whippy. The wind damage proved that such sudden opening should not be resorted to. The damage is not permanent, for the remaining trees will rapidly become windfirm and will, within twenty years, form an absolute complete canopy again. In woods, which had been properly thinned from the start, no such damage occurred. Some damage, however, was caused by the same storm in a small portion of the Karumpoya plantation, 1902, situated within the area in which fellings had been completed. The area referred to contained a mixture of teak and Terminalia tomentosa natural regeneration. When felling the trees marked for thinning, all the Terminalia tomentosa were removed by mistake, leaving the teak trees very scattered. With this storm following shortly afterwards some were broken." [R. Bourne.]

There are several recent instances of teak saplings, two to nine years old, being badly bent by the south-west wind. This kind of damage is not, however, likely to be so common as to be serious.

"In conclusion, it must be recognized that sudden storms and whirlwinds will continue to take their toll, breaking and uprooting trees here and there or along definite tracks throughout the plantations. There is, however, no doubt that such damage can be reduced and eventually minimised by paying attention to the proper development of crowns by thinnings, particularly thinnings at an early age." [R. Bourne.]

90. *Drought.*—Teak regeneration, provided it has had a proper start, early in the monsoon, is not appreciably affected by drought in the hot weather. But lengthy breaks in the monsoon invariably cause heavy casualties amongst teak plants which have not had time to establish themselves during rainy weather.

As regards the artificial regeneration of other species, breaks in the monsoon are probably even more harmful than in the case of teak, and hot weather casualties have been very common in the case of many of the species recently raised experimentally.

91. "*Lightning.*—A certain number of trees are annually struck and wholly or partially killed by lightning. Single trees may be killed. More commonly, however, one or two trees in the centre of a group are killed outright, while many of the branches of the surrounding trees wither and die. Damage by lightning is more frequent in middle aged and old woods than in the younger woods. Nevertheless, an instance of damage by lightning in a one and a half years old teak plantation has recently been seen. The plants were about ten feet in height on the average. Those in the centre of the patch were killed outright, their bark being split from top to bottom while the pithy stem was absolutely dried up. Small, more or less circular, blanks in the plantations are more often than not due to lightning." [R. Bourne.]

92. *Floods and excessive rain.*—High floods are common in the month of July. Low-lying lands are often inundated for a considerable period, at this time. The establishment of regeneration on such areas is a difficult problem. Continuous, heavy rain often causes water to stand for several days at a time on badly drained, stiff, alluvial soils. Such a condition is fatal to teak plants which have just been introduced, and is undoubtedly unfavourable to the growth of teak at any time, especially in early youth. In fact, there are numerous examples of such areas having become unproductive swamps, when replanted with a second crop of teak, after felling the trees of the first rotation.

Heavy floods have been recorded in 1865, 1900, 1902 and 1923, when considerable damage was done in the plantations of these years. But the worst flood damage on record was in July 1924. The whole of one compartment (about 10 acres) of 7-year old teak was destroyed, half the compartment being completely washed away and the other half submerged for so long that all the saplings were killed. In the compartments under regeneration, and those recently regenerated, over 150 acres were flooded and the young plants and saplings destroyed; subsequent efforts to restock them, both when the floods subsided and in succeeding years, have failed, in many cases. Erosion of land along the river banks occurred in various places in the 1924 floods, and every year a certain amount of erosion takes place.

93. "*Fire.*—During the dry weather, January to April, there is considerable danger of fire. Except during the period of flowering of the bamboo, there is no danger of crown fires. No crown fire, however, has ever been recorded or been locally known of. Ground-fires, on the other hand, annually occur throughout the private forests. Their intensity depends upon the growth of grass or the nature and density of other undergrowth. The exterior boundaries of the Government forests are annually cleared and scraped clean to a breadth of 20 to 30 feet. Subsequent to scraping they are kept swept clean of dead leaves, etc., until all danger of fire is over for the year. Such lines have proved extremely efficacious under all normal circumstances. Provided they are clean swept, the only danger of fire crossing them occurs in the first place during the period of flowering of the bamboo from the burning of dead clumps, and in the second place with a high wind in the few open grass areas. High winds during the fire season, however, are only experienced at night, while very high winds are extremely rare. Moreover, the grass is never more than 4 feet in height. In fact, with proper protection, the danger of fire crossing the exterior boundaries is not great. In addition to the natural fire-traces afforded by the rivers and numerous streams, there are a few interior fire-lines in the natural forests, which are cleared, as above, 30 feet in breadth. In the plantations, all plantation boundaries and the boundaries of all compartments within each plantation are scraped 10 feet in breadth. They are not all necessary as fire-lines, but with the heavy growth of grass, weeds and shrubs, etc., during the monsoon, they must regularly be cleared." [R. Bourne.] In his working plan of 1918, Mr. Bourne divided these interior lines in the Nilambur range, into two networks to be cleared in alternate years. In the Amarampalam Range, all the lines were to be cleared annually. His prescriptions have been carried out, and have proved very effective. The few fires which have occurred have either been very small or have done practically no damage to the teak.

"The first record of forest fires dates from 1866. On the 31st March 1866 a fire was reported to have overrun 400 acres of plantations in Pannengode, but not to have done much damage except in the young plantations of 1863. There were, in all, six fires during the year, the majority of which were shown to be due to incendiarism. The plantation boundaries had been fire-traced from the commencement, but Mr. Ferguson then reported that this was the first year in which serious fires have occurred up to the present time in the plantations:—

(i) In March 1869 in Walluvasseri, which ran through about 40 acres of plantation 1865, 80 of 1866, 105 of 1867 and 70 of 1868. About 60,000 saplings were damaged and 2,000 destroyed. They were all coppiced successfully.

(ii) In 1874 in Walluvasseri, over a portion of 1864. As, however, the plantation had been recently weeded, the fire was soon extinguished and very little damage resulted.

(iii) On the 4th May 1879 in Chatomborai, which overran plantations 1872, 1873, 1874 and 1875. It was reported that these young plantations were in fresh leaf and the young leaves were scorched. Eleven thousand seven hundred and eighty trees in 1875 plantation were coppiced.

(iv) On 20th March 1879 in Old Amarampalam over a portion of the 1861—69 plantation. Three thousand eight hundred felled saplings were destroyed.

(v) Early in 1914 in Karumpoya 1908, which overran a small portion of teak and an open grass swamp. It resulted from a fire in the adjoining natural forests as the result of the burning of flowered bamboo clumps. Although the staff were present, they were unable to prevent the grass in the plantation catching fire from the burning brands thrown out by the exploding culms. All damaged saplings were successfully coppiced." [R. Bourne.] The departmental firing of most of the plantations in 1926 will be described in Chapter V. "There are no old records as to fires in the natural forests, but it is tolerably certain that they have been more common than in the plantations. Even so the fire records of more recent years are good. Surrounded as these forests are by private forests, the majority of which are annually burnt from end to end, the result is highly satisfactory." [R. Bourne.]

94. *Grass and weeds.*—Grass and herbaceous weeds are particularly inimical to the regeneration of teak. Many of the old plantations are very open, and the ground is covered with grass, etc. There is, as a rule, little material to burn, when the plantations are clear-felled, and there is thus no chance of killing the weeds. When such areas are replanted with teak, even though the weeding in the first year is well done, a carpet of grass and other weeds quickly establishes itself. A thick mat of weed roots deprives the young plants of much of the food and moisture which they should obtain from the surface soil, and the luxuriant growth of the grass impedes the process of radiation, and would suppress the teak if it were allowed to do so. The paucity of regeneration in many of the natural forests is partly attributable to weed growth, though in the case of some species which are habitually browsed by game, the presence of weeds is, in some measure, favourable to regeneration. (In the artificial raising of Terminalia tomentosa and rosewood it has been found desirable to retain much of the weed growth as a protection against deer.) There is no doubt, however, that grass and weeds hinder the germination of the seeds of most species in these forests, and that they increase the danger of fire and the intensity of such fires as occur.

95. *Climbers.*—Climbers are fairly common both in the mixed timber forests and in the plantations. In bamboo forest alone are they entirely absent. It has been the practice to cut climbers at the time of thinning the teak plantations. Prior to 1918, the thinnings were conducted on a five-year cycle, and the climbers were thus effectively kept in check. But many the plantations have had their final thinning as much as ten years ago, and climbers are now very bad in places. Though the last working plan prescribed that climber-cutting should be carried out where necessary in plantations not due for thinning, the prescription appears to have escaped the eye of the management in many cases. In a number of the young second-rotation plantations also, climbers have been allowed to flourish in the interval between planting and thinning for want of a more definite prescription. The poor development of such plantations is, in some measure, due to this neglect.

96. *Parasites.*—A species of Loranthus is parasitic, particularly on teak and on Terminalia tomentosa. The parasite is spread by birds which eat its fruit. In the plantations the pest is controlled at the time of thinning, or immediately after a thinning, by cutting off and burning the affected branches, when the trees are leafless, and the parasite can readily be detected. As in the case of climbers, the prevalence of Loranthus has increased in many of the plantations which have had their final thinning some years back.

97. *Insects*—(*a*) *Defoliators.*—The most important pests are the teak defoliating caterpillars. Though the presence of these insects must have been noticed long before his time, they were first mentioned by Mr. Lushington in his working plan of 1896, where he stated that a black hairy caterpillar was a great scourge, as it stripped the leaves of whole blocks in some years. The two main agents of the large-scale defoliation so common in the teak plantations have been identified as the caterpillars of the species Hybloea puera and Hapalia machæralis. The results of defoliation are two fold; the production of timber is diminished, and its quality is depreciated. The Forest Entomologist, Dehra Dun, is engaged in studying (amongst other matters) the question of the amount of actual increment which is lost, as a result of the ravages of the insects. The depreciation in quality of the timber is obvious to anyone who has seen the crop of epicormic branches which follow defoliation and which very often persist where there is no underwood to kill them off. The attacks of the defoliators have been recorded, but in a somewhat haphazard manner, for more than twenty years. Since 1924, however, regular and continuous investigation, by and under the instructions of the Forest Entomologist has been carried on, and each attack is recorded and mapped as it occurs. The present writer has not sufficient experience of the plantations to record his personal knowledge of the question. He has, however, seen practically every teak tree defoliated in May 1926 in the Pannengode block. The following is an extract from what Mr. Bourne wrote on the subject in his working plan of 1918:—

"Firstly, a complete defoliation extends rarely over large areas, while partial defoliations may occur throughout the plantations at one time. Secondly, the young plantations around Nedungayam, in the Karumpoya reserve, are unquestionably more intensively attacked than the older plantations around Nilambur. Finally, the intensity of attack rises and wanes from period to period and even from year to year. During the last six years there have been very few general attacks and not a single bad year. It is possible that the abnormal and irregular rainfall during the last few years is largely accountable for this. Attacks are liable to occur in May and June soon after the new flush of leaves has appeared, and again from October to January, after the monsoon . . . There is little doubt that there are certain centres of attack. The writer has noted more defoliation in Edacode (1848), Chatomborai (1874), Pannengode (1886), Karumpoya (1906 and 1897), than in any other areas. In cases of complete defoliation trees, here and there, hardly defoliated at all have been noted. They stand out green in an absolutely brown area. The first thing that generally occurs after a complete defoliation is the production of a mass of epicormic branches from top to bottom of the bole. The new flush of leaves on the crown appears some ten to twenty days later. In the meantime the epicormic branches carry on the assimilatory and transpiratory functions of the crown. It is, therefore, doubtful whether the loss of increment is very great. The epicormic branches, as they develop, thin out naturally, while many more die off as the crown reassumes its normal functions. During partial defoliation the development of dormant buds on the bole is not so strikingly noticeable, but their development under such conditions has been noticed on many occasions. There is no doubt that defoliation accounts for a goodmany of the numerous epicormic branches, which are such a noticeable feature in these plantations. No practical method of combating these pests has yet been suggested. The pureness of the woods has little to do with the question. Scattered teak in the natural forests, far from the plantations, have been seen just as badly defoliated. Looking across a valley at the opposite hill side every single teak tree can be picked out at a glance. Other species, also, such as Terminalia paniculata, in particular, are liable to attack."

In June 1927 Dr. C. F. C. Beeson, Forest Entomologist, wrote an interesting and informative note communicated in Chief Conservator's Proceedings Rtn. No. 225, dated 21st July 1927, on the results of the investigations at his branch, and the lines on which research would proceed. The note is too lengthy to quote in full, but the following is a summary of the important points—the caterpillars of Hybloea puera and Hapalia machæralis are the chief agents of epicormic or large-scale stripping and skeletonizaation. Of other caterpillars, Diacrisia obliqua (a general feeder) frequently defoliates teak, in the absence of the two former species, while caterpillars of Hyposidra (Geometridae), hawkmoths (Sphingidæ) and of Eupterotidae and Lymantridæ are occasional defoliators The beetles which damage teak leaves are cockchafers, weevils (Sympiezomias and Astycus) and chrysomelids. Cockchafers are capable of as much damage to individual trees as are the caterpillars, but they are locally restricted, and abundant only during the rains. Certain grasshoppers (Aularches and other species of Acrididæ) appear to rank in importance with the cockchafers. For Hybloea puera and Hapalia machaeralis a continuous series of 13 or 14 broods per annum is normal in South India, with no resting period. Newly hatched larvae or these two species require tender, new foliage, if they are to survive. It is thus seen that one defoliation by the primary species (caterpillars) provides facilities for further defoliation. The destruction of the foliage of the crown is followed by the flush of new leaves on the stem, and such a condition is just what is required for the survival of the new generation of larvae. The subsidiary pests (beetles and grasshoppers) can assist the primary pests in a similar way. When they destroy old, tough leaves at the time of incubation of the primary species, a crop of stem-foliage is stimulated, and when the caterpillars appear, their food-supply is ready for them. It is this aspect of the defoliation by the subsidiary species which may prove to be serious. Various natural agencies tend to prevent the increase of the primary species, to reduce their numbers and restrict their activities. (The subject of food-supply for the young larvae has been partly dealt with already.) Following the natural leaf-fall of the teak, there ensues a long period of limited food-supply, when many of the insects must die. Survival, during this lean season, depends on the availability of adventitious growth such as early flush, coppice shoots and advance growth, and of alternate host plants. (Vitex nugendo and Bignoniacea have been found to be alternate hosts for Hybloea puera.) Early and intermittent rain, before the monsoon, decimates the caterpillars, killing Hapalia machæralis by its mechanical effect, and setting up a bacterial disease, known as "wilt," in the case of Hybloea puera. Rain restricts the activities of the moths of both species, and oviposition is checked. These conditions are magnified in the monsoon proper. Both species have predaceous enemies, for example, ground-beetles, mantids, ants, spiders, lizards and birds. They also suffer from the parasitism of other insects such as Chalcids, Ichneumonids, Tachinids, etc. These insect parasites offer the most hopeful field for investigating the possibilities of controlling the defoliators. The Entomologist is studying the alternate hosts of the parasites, and the food plants on which the alternate hosts feed. When results are obtained, control could be effected by introducing or encouraging the food plants of the alternate hosts. The most interesting discovery, up to date, is of a Tachinid fly which breeds on the polyphageous Diacrisia obliqua and of another Tachinid breeding on a Glyphodes which feeds on Holarrhena antidysenterica.

(*b*) *Borers.*—Young teak plants are attacked by a borer, the larval stage of Phassus species. It attacks the leading shoot and bores down the pith of the stem. Infection rarely rises above one per acre, or about 1 in 1,000 plants. Infected stems are coppiced." [R. Bourne.]

The forking of the stems of mahogany, which is so common in Nilambur, is said to be due to a borer which attacks the leading shoots.

(*c*) *Insects feeding on fruits.*—The infertility of the seed of Terminalia paniculata has long attracted attention. In 1926 large numbers of the fruits of this species were examined and most of them were found to contain the small larvæ of a weevil, or else the seed had been destroyed and the exit-holes by which the insects had left the fruit were clearly visible. Specimens were sent to Dehra Dun and finally to Europe for identification. The insect has been described as a new species under the name Nanophyes terminalia Mshll.

98. *Animals—(a) Damage to tree growth.*—Elephants are the only animals which cause any appreciable damage to tree growth. Wild elephants often break down teak saplings and strip them of bark in the young plantations of the Amarampalam Range. This kind of injury, however, is chiefly confined to the more open plantations in semi-swampy localities and to small clearings. Government elephants are worse offenders than the wild elephants, because their activities are more restricted. Much of their work lies in the plantations, often out of reach of natural forests, and they have to live near the work. In their search for fodder—which is scarce in the plantations—they break numbers of saplings both of teak and of the subsidiary species in the underwood. In the past they have often stripped the bark from and so injured many teak trees near their cooking sheds that the trees have died. This damage has recently been prevented by erecting stockades round the trees in the immediate vicinity of the sheds. They have recently done considerable injury to the youngest plantations at Nedungayam, but the fault was not entirely that of the elephants. On more than one occasion the writer has seen a mahout deliberately turn his animal loose for the night in a one-year old plantation, simply because the plantation was close at hand and he was too lazy to go a little farther afield. In the working season, the only means of limiting injury to the plantations is to use the stockades mentioned above near the sheds and, as far as possible, to graze the elephants in natural forests where these are not too distant from the camps. When the elephants are sent to rest camps in the hot weather, the rest camps should not be in the plantations. Such an expedient can only be prompted by consideration for the convenience of the subordinates in charge of the elephants, for not only do the plantations suffer, but the elephants themselves are deprived of the better and more abundant fodder which they could get at more suitable camps A recent rest camp in Pannengode plantations was responsible for much breakage of saplings, especially of subsidiary species in the understorey in the Pokode block close to the camp.

(*b*) *Damage to regeneration.*—"The most serious damage to new teak plantations is caused by cattle and monkeys in the year of formation. Damage by the former is confined at present to the plantations under regeneration in the vicinity of Nilambur where the village cattle are allowed to stray wild into the private forests and plantations. They trample down the young plants and occasionally nibble the leading shoot of the small teak. They are so wild that to impound them an army of coolies is required. The remedy applied has been to institute a pound adjacent to the area and to fence the new plantation with wire and bamboo brushwood. With the imposition of maximum compounding fees this has proved partially successful." [R. Bourne.] Since Mr. Bourne wrote the foregoing sentences, the fencing of such young plantations has been discontinued, presumably on the grounds of expense. The enforcement of the closure of the plantations to grazing has been relaxed, for, whereas 112 cases of illicit grazing were reported in 1918–19, there were only 37 cases in the following year, none at all from 1920–21 to 1923–24, 1 in 1924–25, 1 in 1925–26, and 9 in 1926–27. In the present year (1927–28) vigorous steps are being taken to punish offending owners, but it is said that the imposition of compounding and pound fees is conducive to bad feeling towards the Forest Department, while there is little or no improvement in the situation as regards grazing. The trouble is that the villagers have never made a practice of employing herdsmen to graze their cattle, and that, though all the Government forests are nominally closed to grazing, the rule has usually been disregarded both by the cattle owners and the Forest Department. The damage is, however, too serious to be neglected, for, even apart from the breaking of young plants, the ill effects of trampling the soil are most unfavourable to the already precarious prospects of the second rotation teak. Monkeys break off the tender bud of the leading shoot of young teak plants, bite it and throw it away. The damage is chiefly amongst plants up to three feet in height and is most common where the young plantations adjoin plantations or forests of tall trees. Forking results, but fortunately the injury can be corrected by careful pruning at the end of the first year. Deer, which are very numerous in both the Nilambur and Amarampalam Ranges, browse the leading shoots of young teak to a certain extent, while in the few instances in which plantations of Dalbergia latifolia and Terminalia tomentosa have been made, browsing has been so bad that most of the weed growth has usually been left as a protection. Attempts to grow Bombax malabaricum and Eriodendron

anfractuosum have been completely frustrated by deer. Bison have been responsible for some damage to young teak plantations in the Amarampalam Range, but injury from this source is not very serious. It has, so far, been found practically impossible to grow Artocarpus integrifolia, because of the attention of various animals. Monkeys are the worst offenders, pulling up the plants and seedlings, and eating the fleshy seeds. Squirrels, rats and porcupines also eat the seeds, while cattle and deer browse the surviving plants, and monkeys break off the leading shoots. Artocarpus hirsuta suffers from similar depredations, but to a less degree.

99. *Man.*—"Apart from the report that certain fires which occurred in 1863 were due to incendiarism, the sole records relate to the difficulty of protecting these forests from thefts of timber, etc. In 1865, Mr. Ferguson expressed the difficulty he experienced in preventing theft, drawing attention to the peculiar situation of the forests in scattered or straggling blocks, surrounded by private forests. In 1906, Mr. Lushington remarked on the facility with which theft was possible, but expressed the opinion that this was not being taken advantage of. From recent experience there is no question but that a certain amount of timber theft has gone on regularly. With such extensive annual departmental fellings, it is essential, on the one hand, that a complete check on all timber, etc., should be kept from the date on which it is felled until it is finally sold. Up to 1913 this used not be the case, simply for the reason that any time from one to ten months elapsed between the date of felling and the date of measurement. This has successfully been remedied and all timber is now numbered and measured practically on the day it is felled, and brought to book in the same month. Within a month or so it is checkmeasured by a special officer and is liable to be rechecked by still higher authority. This double and potential treble check permits of early reconciliation of all discrepancies and is essential to the prevention of theft by or with the knowledge of the staff. It is also essential, on the other hand, that the controlling authority should have timely knowledge of all felling in such private forests or lands as are tapped by the same timber export routes as the Government forests. It is only under such circumstances that it is possible to check where timber in the possession of private persons has come from. A set of timber transit rules were elaborated in 1915 with this end in view and brought into force from the 1st April 1916. After two years' experimental working they were reported on and certain modifications for the facilitation of procedure have been recommended." (R. Bourne?)

Since the introduction of these modifications, the working of the transit rules is said to have been satisfactory. From 1918–19 to 1926–27, both years inclusive, only two timber theft cases of any importance have been detected. One, which involved the felling, conversion and transport of several rosewood trees from the old Amarampalam plantations, was committed with the connivance, if not at the actual instigation of several forest subordinates, and Government elephants, carts and buffaloes were employed in a most audacious manner. After investigations, one forest guard was dismissed, three foresters were suspended, and the range officer was debarred from promotion for two years. In the other case, five Xylia trees were felled, for sleepers, in the Kariem block. The felling was done by the coolies of a contractor who was extracting sleepers from the adjoining forests of the Nilambur Tirumalpad. His defence was that the coolies did not know the boundaries of the Government forests. The case was compounded for Rs. 100. The possibility of similar theft is always present and illicit felling is probably not so uncommon as one would infer from the rarity of the offences which are reported. The outlying blocks are surrounded by private forests in which extraction is constantly in progress, and there is so much work to be done in the plantations that the protection of the more remote forests is left largely to chance. It is hoped that the programme of departmental works prescribed in this working plan will enable the staff to devote more attention to protective duties.

" Owing to the situation of the Government forests surrounded as they are by private forests and waste lands, they are peculiarly free from such pernicious practices as lopping for leaf manure, etc. In the case of enclosures only are cultivators allowed the concession of clearing all the undergrowth within twelve feet of the fields, subject to their obtaining in writing a renewal of such concession annually.

With the exception of regular timber thieves, the population as a whole are conscientious respecters of the Government forests. Administration reports show that there are fewer petty offences than in any other division in the Presidency. This is, no doubt, due to the fact that these forests largely came into the possession of Government before the locality was opened up, with the result that the present population and their forbears have never felt that they had any claim thereto." (R. Bourne).

CHAPTER III—UTILIZATION OF THE PRODUCE.

SECTION 1—AGRICULTURAL CUSTOMS AND WANTS OF THE POPULATION.

100. *The local population.*—The Nilambur village marks, approximately, the northern limit of the densely populated part of the Ernad taluk. The surrounding country is undulating and consists typically of paddy lands or uncultivated swamps in the depressions surrounded by forests of some kind or another on the slopes. There is little dry cultivation. Going south-west, south, or south-east from Nilambur, the proportion of paddy lands to forest increases, while the reverse is the case as one proceeds in northerly directions until the forest-clad hills are reached and cultivation ceases altogether. About one-third of the present local population is permanently employed in the timber industry and this number increases during slack seasons in the fields. Most of the remainder get their livelihood from agricultural work usually as the servants of the jenmis and of their tenants. The Nilambur village is increasing in size and importance. The new railway has been opened too recently for its full effects to be appreciated, but already it has caused a marked increase in the weekly influx of people to the local market (always an important one in these parts) and this is bound to cause an increase in the permanent community of small traders. In course of time the railway is certain to add considerably to the prosperity of the village and to attract settlers, chiefly in connexion with the timber trade. A private saw mill is nearing completion and if this or a similar enterprise succeeds it will help to enhance the importance of Nilambur.

101. *Wants of the people.*—The vast tracts of private waste forest which are situated close to the village and to the cultivated lands, supply all the wants of the people in the way of small timber, fuel, bamboos thatching grass, grazing, green leaf manure, etc. There seems no immediate likelihood of any local demand being made on the Government forests for the supply of these miscellaneous requirements.

SECTION 2—MARKETS AND MARKETABLE PRODUCTS.

102. *Markets.*—At the time of writing this report, the only important market and centre of supply is Beypore, seven miles south of Calicut, and at the mouth of the Beypore river. Thither practically all of the Nilambur timber is transported down the river in rafts. From the Government sale depot at Beypore, most of the timber goes to supply the big timber industries of Kallai (saw-mills, hand-sawing, ship-building, furniture and cabinet-making, etc) and the export trade both in round and sawn timber. Kallai is between Beypore and Calicut, and is connected with the Beypore river by means of the Conolly canal. From Kallai and Beypore timber is exported by rail to the various inland centres of demand in the Madras Presidency and Mysore, and by coasting vessels to ports along the western seaboard of the Madras and Bombay Presidencies, and to Arabia and the Persian Gulf. Teak is the principal timber exported by sea. In 1922 and 1924 small quantities of specially selected logs of Terminalia tomentosa and Lagerstroemia microcarpa and planks of teak were exported direct to London for sale, and for the British Empire Exhibition (1924), and were sold at high prices by the London agents of the Madras Government.

103. *Sale depots and saw-mill.*—Government has two sale depots on the coast—a large one at Beypore and a small one at Kallai. The Kallai depot is not, however, used at present, and the land is leased temporarily until such time as it may again be required. Early in 1925, in order to reduce the large stock of timber which had accumulated during a serious slump in the timber trade, a small portable saw-mill

was installed in the Beypore depot, and timber which could not profitably be sold in the log was sawn in the mill, and sold in the form of sleepers, scantlings of various sizes, reepers, etc. This saw-mill can take about 10,000 c.ft. of timber in a month. It is still operating, but its future is uncertain. The timber trade has now improved considerably and prices are on the rise. Probably it will soon prove more advantageous to Government to sell all the Beypore timber in the log, and the mill, having served its purpose here, may be more profitably employed elsewhere.

104. *Method of marketing.*—Prior to 1926 all sales were effected by the District Forest Officer, and most of the timber was sold in auction. Subsequent to the appointment of a Forest Utilization Officer in Madras in 1924, special orders were occasionally placed by that officer. In September 1926 the Beypore depot was taken over by the Forest Utilization Officer and he is now responsible for marketing all the timber, bamboos, etc., which are sent down to the coast, i.e., practically all the outturn of the forests. Much of the business is transacted by public auction. Sleepers are passed by the Forest Utilization Officer and delivered to the railway at fixed rates. Standard rates for retail timber sales are fixed and revised from time to time. Part of the outturn of the saw-mill, as well as some timber in the round, is sold in Madras and elsewhere through an agent. Contracts for supplying certain particular demands are entered into by the Forest Utilization Officer, and in this way high prices are sometimes realized for selected timber and for timber sawn to order.

105. *Local sales.*—In the foregoing paragraphs the main demands and the means adopted for meeting them have been described. Local sales were discouraged by Mr. Bourne in his working plan on the grounds that most of the profit found its way into the pockets of the contractors, and during the last decade such sales have been confined to the poorer timber from natural forest clearings, to natural forest timber which the management could not conveniently handle departmentally, to casual lots of timber, e.g., timber inadvertently left behind during regular extraction or felled in localities other than the main felling areas, and to the smaller teak poles which could not be profitably extracted by Government agency. The coupes were sold standing to contractors in 1922–23 and about 61,000 cubic feet were removed. The other local sales were in respect of timber which was felled and dragged by the department, but not floated nor carted outside the forests. The prices realized have been on the whole reasonable. For the utilization of some of the teak branchwood in the final felling coupes, the District Forest Officer sometimes auctions the right to fashion and remove spokes and felloes and other pieces suitable for cart-building. With increasingly heavy exploitation in the local private forests, Nilambur has become the headquarters of a number of well-to-do timber merchants. They would welcome the opportunity of dealing with Government, since big timber is now very scarce in the private forests, and is practically confined to the more remote localities. Unless the present departmental rates for extraction can be considerably reduced, it seems possible that sales in the forests, either of standing or felled timber, may prove more profitable, at least in some cases, than the existing system. The recent opening of the Shoranur-Nilambur railway also brings up the question of local sales, or of Nilambur becoming a centre of distribution to the inland towns. Further, a small private saw-mill is in course of erection in Nilambur, and the success of this or a similar enterprise will certainly necessitate some changes in the existing system of handling the outturn of the forests.

106. *Marketable products.*—Timber (both in the log and in sawn sizes), poles, minor produce, bamboos and fuel are all available for sale, but the prices for bamboos and fuel are not sufficient to make it profitable to extract them specially.

(*a*) *Timber.*—More than half of the timber supplied to the market in recent years has been teakwood from the plantations. Practically all the remainder has come from clearings made in natural forests prior to planting. Of the natural forest timber, Terminalia paniculata forms about 60 per cent of the outturn. The other valuable species are Xylia Xylocarpa, Lagerstrœmia microcarpa, Terminalia tomentosa, and small quantities of teak, rosewood and Pterocarpus Marsupium. Most of the other species extracted from the natural forests have been classed as 'junglewoods,' and sold as such, without classification into sale lots by species. Subsequent

to 1925 no jungle woods have been removed from the coupes, as the prices obtainable were found to be less than the cost of extraction. The teak timber is classed, by size, into six classes. The other valuable timbers are sold by species and are not classified, except in so far as to avoid mixing big and small logs in the same sale lots. Sawn timber is, of course, sold by species in the various sizes which the mill turns out. Sleepers are sold at rates fixed for the particular species and gauge of the sleeper.

(*b*) *Poles*.—Up to date, the sale of poles from Government forests has been practically confined to teak. Except during periods of dulness in the market, these poles are saleable, at a profit, down to quite small sizes. The market is now recovering from the slump which followed the war time inflation of prices, but only very low rates are as yet obtainable for the smaller poles. It is too early to predict whether there will be sufficient recovery in price to make the smallest sizes pay their way once more. For marketing the teak poles there is a very elaborate system of classification, which has been in force since 1865. It enables Government to realize the highest possible price for each particular class. It is believed that there is some demand from Arab merchants for the larger sized poles of Terminalia tomentosa, and it is certain that poles of this species and of Lagerstrœmia microcarpa find a sale, for they are regularly extracted from private forests. In disposing of poles, one very important point must be remembered, and that is that the market demands fresh stock. When a long period elapses between the felling and the marketing, the prices drop considerably. Slow-grown, suppressed poles are preferred to fast-grown poles, as the latter have a more open grain and a lot of sapwood. (This point is only mentioned in passing. Since thinning is a silvicultural operation, it must not be influenced by any external considerations.)

(*c*) *Minor produce*.—The right of collecting minor forest produce is leased out annually by ranges. The following products are included in the leases :—Fruits of all kinds, seekai, roots, honey, wax, ginger, dammer and turmeric. Horns are never leased out, because the usual method of collecting them includes firing the forests. The last working plan prescribed that the minor produce leases should be discontinued, as the lease amounts obtainable were considered trifling. This prescription has been disregarded, and it is proposed to continue to give these leases, since fires and other forest offences are of rare occurrence. Canes are available in the evergreen forests, but they have seldom been sold, on the grounds that the usual method of collection exterminates them. Up to Rs. 1,200 has been paid for the right to remove canes for one year. There is good demand for them in Tellicherry and Mahe and there seems no good reason why Government should not take advantage of this fact.

(*d*) *Bamboos*.—Bambusa arundinacea is the only indigenous bamboo which grows in any quantity in the Nilambur forests. Dendrocaamus strictus is known to the writer in a few small patches only, and introduced bamboos are so few as to be negligible. Large quantities of bamboos are extracted annually for floating the timber. Only hardened culms are used, and they are cut some twelve to fifteen feet above the ground. Except in the years following extensive flowering, there is no difficulty in procuring more than sufficient bamboos for this purpose. They are sold in Beypore when the rafts are untied. Owing to the large areas of private forests. devastated of most of their timber but containing such bamboo, good prices are rarely obtainable In fact, the bamboo operations have frequently shown a loss, and the profit is never considerable. Bamboos are sometimes sold standing in the forests on payment of seigniorage. But there is very little demand of this nature owing to the abundance of bamboo in private forests.

(*e*) *Fuel*.—Practically no fuel has ever been specially extracted from these forests, as there is no local demand. In Calicut there is a big demand, which is supplied chiefly by private forests situated nearer to the coast. 'Karias' (cross-pieces, usually of junglewood saplings, used in tying rafts) and waste from the saw-mill are sold as fuel in the Beypore depot. There is no possibility, at present, of exporting fuel from the forests at a profit, but if the new railway makes such a proposition practicable in the future, abundant supplies can be made available.

107. *Statement of classification of timber and poles*—

Classification of timber—sold by cubical contents.	Measurement by centre quarter girth.
(1) Short logs	Under 18 feet in length and over 3 feet in centre girth under bark.
(2) Logs under 2 candies ...	Nine cubic feet and under 26 cubic feet in contents.
(3) Logs 2 to 4 candies... ...	Twenty-six cubic feet and under 52 cubic feet in contents.
(4) Logs 4 to 6 candies... ...	Fifty-two cubic feet and under 78 cubic feet in contents.
(5) Logs 6 to 8 candies	Seventy-eight cubic feet and under 104 cubic feet in contents.
(6) Logs 8 candies and over ...	One hundred and four cubic feet and over in contents.

Classification of poles—sold by the pole.	Measurements.
(1) Measurable	Over 7 inches diameter under bark at the base and containing less than 9 cubic feet in contents. It has, therefore, to be measured.
(2) Superior small	Over 18 feet in length and exactly 7 inches diameter under bark at the base. Average cubical contents 4·7 cubic feet
(3) I class	Over 18 feet in length and 6 to 7 inches diameter under bark at the base, which is equivalent to $20\frac{1}{2}$ to $23\frac{1}{2}$ inches in girth over bark at 4 feet 6 inches. Average cubical contents 3·5 cubic feet.
(4) II class	Over 18 feet in length and 5 to 6 inches diameter under bark at the base, which is equivalent to $17\frac{1}{2}$ to $20\frac{1}{2}$ inches in girth over bark at 4 feet 6 inches. Average cubical contents 2·3 cubic feet.
(5) III class	Over 18 feet in length and 4 to 5 inches diameter under bark at the base, which is equivalent to $14\frac{1}{2}$ to $17\frac{1}{2}$ inches in girth over bark at 4 feet 6 inches. Average cubical contents 1·4 cubic feet.
(6) IV class	Over 18 feet in length and 3 to 4 inches diameter under bark at the base, which is equivalent to $11\frac{1}{2}$ to $14\frac{1}{2}$ inches in girth over bark at 4 feet to 6 inches. Average cubical contents ·75 cubic foot.
(7) V class	Over 18 feet in length and $2\frac{1}{4}$ to 3 inches diameter under bark at the base, which is equivalent to 9 5 to 11·5 inches in girth over bark at 4 feet 6 inches. Average cubical contents ·46 cubic foot.
(8) VI class	Abolished in the past.
(9) VII class	All very crooked poles of whatever size. Average cubical contents 1·1 cubic feet.
(10) VIII class	Under 18 feet in length and under 3 feet in centre girth under bark. Average cubical contents 3·1 cubic feet.

SECTION 3—LINES OF EXPORT.

108. *Lines of Export.*—The Nilambur Valley forests are surrounded on the north-east and south-east by steep hill ranges and are within the watershed of the Chaliar river which flows westwards to the coast. Floating is the cheapest method of transport, and since the coastal market has been the only market of importance in the past, it follows that this river is the main line of export. That other export routes will be used in the near future is certain. The Shoranur-Nilambur railway has just been completed, and this will make it possible to rail timber direct to all inland centres of demand. It only remains to get in touch with markets which, through lack of means of communication, have not as yet been supplied direct from Nilambur. Further, it is only twenty odd miles by road from Nilambur to the Nilgiri-Wynaad, where there are large areas of tea gardens, and where this industry is rapidly expanding. Nearer, still, to Nilambur there are four rubber estates. For the export of their produce the planters require large quantities of boxes, and if a satisfactory plywood plant were to be installed in or near the forests, this demand could be met more easily from Nilambur than from elsewhere.

Section 4—Methods of Expolitation.

109. *Agency of exploitation.*—During the past decade practically all the works of exploitation have been undertaken by the Forest Department. Instances of the sale of standing timber, and of sales in river and roadside depots have already been mentioned. With such exceptions all timber has been felled and dragged by departmental agency. Till 1922 rafting and floating also were done departmentally, but at present a contractor undertakes this work in the Nilambur Range. Carting is practically confined to the transport of timber from natural forest coupes, in the Amarampalam Range, to the rafting place at Nedungayam ; both Government carts and private carts are employed. Minor forest products are collected and removed by purchasers. Spokes and fellows, when sold, are fashioned in the coupes by the purchasers, and removed by them. The various exploitation operations may now be described separately.

110. *Marking for felling.*—Most of the trees to come out in thinnings are marked by a gazetted officer. Sometimes this work is entrusted to an Assistant Ranger. Marking is done either with whitewash, or with an implement called a " risser" which removes a narrow strip of bark. The marks are made at about breast-height. When whitewash is used, a band is painted round the stem. With the " risser" two crosses are cut at opposite sides of the tree. The latter method is the better, since whitewash may be partially obliterated in the interval between marking and felling. At present the trees marked for thinning are not counted till after felling. (This is a mistake which should be avoided in future.) Prior to final felling in the teak plantations, all exploitable trees are numbered serially at breast-height, with chisels, and the girth at breast-height is measured. The height of exploitable bole is estimated by eye, and details are entered in an enumeration register. The work in each compartment is usually entrusted to a Forester working under the Ranger in charge of fellings and is supervised by the Range Officer. Partial check by a gazetted officer is desirable. The same procedure has sometimes been adopted in the case of clear-felling natural forests preparatory to planting, though recently it has been more usual to omit such enumeration and marking. Selection fellings in natural forests (as an advance prescription of this working plan) are in progress at the time of writing. The trees are being marked by the Range Officer and his assistant Ranger, and marking is subject to check by a gazetted officer. Serial numbers are marked with art, at the base of the tree and the breast-height girth, together with an estimate of the length of exploitable bole, are entered in an enumeration register.

111. *Felling and preliminary classification.*—The fellings commence in August or September, and are continued until about the end of May, whereafter most of the available labour and the forest staff are concentrated upon regeneration work. Areas to be clear-felled for regeneration are undertaken first. Felling is done by axe, and the coolies are such good axemen that the waste is scarcely appreciable. Saws have recently been used, on a small scale. Cross cutting of logs is usually by saw. A forester, generally assisted by a forest guard, is placed in charge of the felling in each locality. He directs the work of cutting off the crowns and branches, after felling, and dividing the trees into logs when necessary. Provided trees are straight and sound they are not subdivided, unless they have to be carted and are of excessive size for this purpose. The felling coolies undertake the dressing of logs, and they cut drag-holes when necessary. The felling forester is also accompanied by a number of special coolies who chisel, on the stumps, the numbers of the trees as recorded in enumeration register. They also chisel serial numbers on the wood of each log, and on poles of the " measurable " class, and remove the bark at the centre. The Forester then measures and classifies each log and measurable and posts his felling register. In the case of poles below the class of measurables, he simply inscribes the denomination on the bark, and enters the daily total of each class in the register. (In executing thinnings there are certain differences in the procedure now followed. The stumps are hammer-marked as the trees are felled, and the trees are counted, for the first time, after felling. Measurement, classification, numbering of logs and measurables, marking of other poles, and posting

of the felling register, by the forester, are as described above). Classification of all poles other than measurables is done by means of diameter gauges. The whole of this work is done on the day of felling, and a duplicate of the felling register is submitted to the District Forest Officer through the Range Officer each evening. Fellings in natural forests are usually done on piece-work contract, at fixed rates per cubic foot, or per candy of 13 cubic feet. Thinnings are carried out by coolies on daily wages. For final fellings in plantations, payment is made at fixed rates for each log or pole, according to its class.

112. *Check-measurement and final classification.*—In each Range an assistant ranger is placed in charge of all felling operations, and the foresters working in the various felling localities are supervised by him. As soon as possible after felling (often on the same day) this ranger does the final measurement and classification. The description and actual dimensions of each log and measurable, and the denominations of all other poles, are then chiselled on the wood at the butt end. The ranger posts the final classification register and submits a duplicate to the District Forest Officer through the Range officer at the close of each day's work. When all the fellings in one locality are completed, the originals of the felling and classification reports (which are in one combined register) are sent to the Range officer and retained in his office. The entries in this register should be identical with those filed in the District Forest Officer's office. A proportion of the fellings are subsequently checked at stump site by the District Forest Officer or his gazetted assistant.

113. *Dragging and carting to river-side depots.*—Removal of timber from stump-site may take place any time after the final measurement and classification. Full-grown and middle-sized elephants drag all logs except the smallest, while small elephants and buffaloes drag the poles and some of the logs under 20 cubic feet. The Burma type of elephant-dragging harness is used. Buffaloes drag in pairs, and the poles are suspended from the yokes by chains round their thicker ends. The dragging capacity of each elephant is fixed, and as far as possible elephant power is used to the best advantage, i.e., suitable loads are given, and big elephants are not used for dragging small logs. In the case of the largest logs, teams of two, three or four elephants are used, as required. Private elephants are sometimes hired when the Government livestock is insufficient to cope with all the extraction work. Drag-holes are always made in the butts of logs felled in natural forests, and dragging is facilitated by the rounding off of the butt during felling by axe. Until recently, dragging of teak logs was done in the same way, but at present no drag-holes are cut in the teak felled in the Nilambur Range, on the grounds that such procedure wastes some of the butt timber. Instead, the logs are dragged by means of chains round the smaller ends. This imposes an additional strain on the elephants, and there is a tendency to tear the fibres of the logs. The method also involves very hard wear on the chains. It will probably be advisable to revert to the old method of drag-holes, at any rate in the case of the larger logs. Drag-holes have never been cut in poles, and are unnecessary. Where the felling localities are close to the floating rivers, the timber is dragged, from stump-site, either direct to river-side depots, or else to intermediate depots outside the felling areas. Dragging to intermediate depots has often been found necessary, of late years, in clearing the coupes in plantation final fellings, owing to the necessity of getting all the timber off the area preparatory to regeneration, and to the impossibility of finding sufficient space for storing large quantities of timber close to the rafting places. The use of intermediate depots involves extra work and expense, but it is claimed that the possibility of theft and of logs being washed away by floods, is less than if all the timber were stored on the river bank until floating can commence. River-side depots are situated at every point on the bank at which rafting is possible. To them the timber is dragged, either from stump-site at the time of clearing the coupes, or from intermediate depots just before floating commences. Where possible, carts are used to reduce the dragging leads, and in the Amarampalam Range most of the timber from recent clear-felled coupes in natural forests has been carted to Nedungayam (the nearest rafting place). In some localities carts can be taken into the coupes; in others the timber must first be dragged from the coupe to the nearest road or cart track. In the Nilambur Range no carting has been possible from the coupes of recent years. For dragging and

carting a special register is maintained by the subordinate in charge of the work, usually a forester. In the Nilambur Range it is posted when logs are dragged to intermediate depots, and again when they are dragged to the river side. In the Amarampalam Range, where the possibility of theft is practically negligible, the register is not posted until the timber reaches the rafting places, irrespective of the fact that it may have remained in road-side depots for some time after being dragged from stump-site. The numbers and classification of all logs and measurables, and the total number of each class or other poles, together with the date of dragging or carting, are posted daily, as the work proceeds. A duplicate of this register is sent, every day, to the Range officer, who completes the form by entering in it the page number of the final classification register in which each log was classified, and usually the volume of each log is also added, though there is no special column for this entry. At the same time he enters, in the final classification register, the date of dragging or carting, and the page number of the entry in the dragging register. He then submits the duplicate of the dragging register to the District Forest Officer, and the latter posts his final classification register in the same way. The contents of river-side depots are checked, from time to time, by a gazetted officer.

114. *Dragging to rafting place.*—Timber can be tied into rafts in any place where there is sufficient depth of water to move logs easily when practically submerged, and where the current is not too strong. Dragging from river-side depots down to the rafting places is done entirely by elephants. They drag the logs out into the stream and swing them round parallel to the current. Big elephants are usually employed.

115. *Tying into rafts.*—Since 1922, rafting and floating of timber from the Nilambur Range have been done on contract. Attempts at contract floating in the Amarampalam Range have not been successful, and the work is still done departmently. The rates paid to the floating contractor are very high, and if sufficient elephants are available in the future it may be found desirable to revert to departmental floating for all the timber which is sent down for sale to the coast. Mr. Bourne's description of these works may now be quoted :—" Tying into rafts is absolutely impossible when the river is in flood or at all high. Moreover it is very difficult to prevent any rafts in the river at such times from being washed away and carried right out to sea. Such logs are sometimes recovered washed ashore some way south of Beypore. In normal years the river rises sufficiently to render floating easy in June. Floods are rarely experienced before July. However, ten days heavy rain consecutively will mean a flood. Later in the year, when the ground is saturated, three or four days of such rain will suffice. Provided a careful eye is kept on the weather, some 100 rafts or so may be tied in June and floated at once. If this is not possible, rafting commences in August. It should, if possible, be completed by the end of November on the main rivers and by the end of October on smaller rivers. Since only big elephants can be used for this work, they ought to be concentrated on it from August to November. If all the big logs cannot be dragged before August, other means of dragging such logs should be introduced. The timber is usually floated green, since it was supposed to lose nearly half of its local value if not seasoned in salt water on the coast. "

Recently, however, some of the plantation teak in final felling coupes has been girdled a year before felling, so that floating could be done with few or no bamboos. Girdled teak and green teak are being sold separately at Beypore, and up to date there seems to be no difference in the prices realized. It is certain, however, that poles must be put on the market as fresh as possible. Bamboos have to be used as floats for green timber.

" Fifty to one hundred and fifty bamboos are used per raft according to requirements. They are cut, dragged or carted to river-side depots by buffaloes, and floated down to the timber rafting places. They are there tied into bundles. With the number of bamboos required for a bundle known, half are placed with their butt ends one side and half with their butt ends the other. The whole number are then tied with ropes into one bundle, a rope round each end and one in the middle. Two such bundles are used for one raft. According to the size of the logs, one, two, or three are placed side by side between the bamboo bundles and all tied together by

means of three junglewood cross-pieces and ropes. One smaller log is then generally tied on each side, outside the bamboo floats, to protect the latter. Such are the rafts which are then floated down the river some thirty or forty miles to the coast. Poles are tied into rafts in more or less the same way. All poles in one raft are of the same class. For instance eight measurables, twelve superior small, etc. In the case of small logs under 2 candies or 26 cubic feet, the same applies, five being placed in one raft. In the case of larger logs, they are generally put between the bamboo floats, with smaller logs outside. This procedure facilitates checking and stacking in the depot at the other end." A floating permit is prepared, in triplicate, for each raft, as soon as the rafts are tied. The Range officer keeps the counterfoil, gives one copy to the floating contractor or to the subordinate who goes with the rafts, as the case may be, and sends the third copy to the District Forest Officer. Both the District Forest Officer and the Range officer post their respective copies of the final classification register, and the District Forest Officer sends his copy of the permit to the checking officer at Mundayanthodumukku checking station.

116. *Floating.*—" Upstream from Mambad, floating is always difficult in places on account of the rocky nature of the river-bed and the rapids. From the rafting place to the checking station at Mundayanthodumukku or, when the river is fairly low, further on to Peelikandanpara a raftsman is sent in charge of each raft. At those points they are collected and tied together into consignments containing 50 to 150 rafts, which are then floated to Beypore in charge of a few men. When floating has to be continued late in December or in January, rafts have to be taken singly as far as Chaliarpuram, some sixteen miles downstream from Nilambur. From this point the river is tidal and consignments can always be floated to Beypore at high tide. In these circumstances, it is perfectly clear that all dragging and tying into rafts should be completed by the end of November at latest or the cost of floating must rise out of all proportion."

In the case of departmental floating a subordinate (usually a forest guard) accompanies each consignment of rafts to Beypore. Elephants have often to be employed in assisting rafts of big logs over the shallow reaches of the Karumpuzha below Nedungayam. When rafts reach Mundayanthodumukku their contents are checked by the checking officer, from the copy of the floating permit sent to him by the District Forest Officer. He posts his daily check register and forwards his copy of the floating permit to the Depot Range officer at Beypore. The latter also receives a consolidated invoice of each consignment of rafts, from the Range officer of the Range from which the timber is despatched. The Depot Range officer checks the rafts on arrival at Beypore, and sends the permit (received from the checking officer) to the District Forest Officer, with the numbers, and his own measurements of the logs delivered. He counts the bamboos and " karias " (cross-pieces) received with each consignment of rafts, and sends a statement to the District Forest Officer. A loss, en route, of 3 per cent in the case of bamboos and ·10 per cent in the case of karias is the limit admissible at present. Losses in excess of these percentages render the floating contractors liable to fines, and the floating subordinates to departmental punishment.

117. *Stacking in sale depot.*—The sale depot at Beypore is now in charge of the Forest Utilization Officer, Madras. Stacking of timber is done on contract, species by species and class by class, in small lots, of a fixed number for each lot, ready for sale. Bamboos and karias are also collected into sale lots, the latter being sold as firewood.

118. *Timber Registers and forms.*—In 1925 a new system of timber registers and forms was introduced, in connexion with the commercial system of accounting, and the forms prescribed in the Madras Forest Code were discontinued. The new registers and forms have been found to be much superior to the old forms, and though the system of commercial accounts is likely to be discontinued in the near future, it is strongly recommended that the new timber forms should be retained. In the foregoing paragraphs the posting of these forms at the various stages in the course of extraction has been described. Samples of the final classification and felling register (printed in one book) and of the dragging register (also used for carting) will further explain the new system, and they are given below :—

FORM 4-C. No.

Daily Felling Report.

Species. (1)	Log No. (2)	Length, feet. (3)	Girth, inches. (4)	Cubical contents. (5)
Total				

Summary		
Classification.	Number of logs.	Cubical contents

Range

Date

Forest Ranger.

FORM 5-C. No.

Final Classification.

Log. No.	Length, feet.	Girth, inches.	Cubical contents.	Classifications.	Dragged to river.		Floated T.T. Permit Number.	Disposal Invoice Number.	Received at Beypore.			
					Date.	Form No. 11-C.			Length.	Girth.	Contents.	Difference or
(1)	(2)	(3)	(4)	(5)	(6)		(7)	(8)	(9)	(10)	(11)	(12)
	Total											

Summary.			For use in District Forest office.			
Classification.	Number of logs.	Cubical contents.	Folio No. 6-C.	Date posted.	Initial.	Remarks.
Total						

Range

Date

Forest Ranger

In the daily felling report an additional column is now entered before column (1) and in it is posted the enumeration number of the tree from which each particular log is obtained.

FORM 11-C. No.

Logs dragged to river this day.

Log No.	Form 5-C No.	Classification.	Log No.	Form 5-C No.	Classification.

Summary.		Form 5-C No.
Classification.	No of logs,	

Range

Date

Forest Range Officer.

Section 5—Cost of Exploitation.

119. *General review.*—During his five years' tenure of office as District Forest Officer, Nilambur, Mr. Bourne was able to calculate, from actual experience of working (mostly on daily labour) the cost of each extraction operation for each class of timber and poles, and from these data he worked out tables of rates for the same works if done on contract. Assuming that Mr. Bourne's figures were correct, the same rates should still hold good, for wages at the present day are much the same as those on which he based his calculations. It is probable that most of his calculations were correct, though a few of his rates are so low that it seems impossible that they could ever have been enforced. The present writer has had no such opportunity of working out detailed rates. At the present time, flat rates for groups of classes of logs and poles are often the rule, and owing to the destruction of records in the Malabar rebellion, figures for a few years only are available, and these are for the rather abnormal years of reconstruction after the rebellion, and of disorganization due to lack of continuity in office of executive officers. For these reasons a comparison of existing rates with those in force in 1918 is not satisfactory, and a detailed comparison is impossible owing to lack of full details. The present rates are, in practically all cases, higher than the 1918 rates. Most of them are susceptible to some reduction, and some to very considerable reduction. It is very easy to allow rates to rise, but it is extremely difficult to reduce them. The attempt will have to be made gradually, and it is suggested that the best way of tackling the question in the case of piece-work rates, is to do each item of the work on daily wages, under closer supervision than would ever be possible on a big scale, and then to strike a rate somewhat higher than the actual cost. In the following paragraphs such rates as are available at present will be quoted, and Mr. Bourne's figures will also be given as a standard at which to aim. If rates can be reduced below those given by Mr. Bourne this must, of course, be done.

120. *Total cost of production.*—Since the introduction of the commercial system of accounting, the chartered accountants have worked out the details of all production costs at the annual audit. Their rates, however, are the averages for the total annual production of timber and poles from final fellings, and do not include thinnings. The most interesting feature in the following comparison of production rates is the demonstration of the reduction in rate of overhead charges for a certain increase in outturn. Production can be expanded considerably without increasing the total overheads, so that further reduction of the overhead charges per unit of material is possible.

Cost of production.

Column No.		1925–26.	1926–27.
1	Total production used in the calculations	Columns 2 to 5—269,835 cubic feet. ,, 6 to 9—282,993 ,,	Columns 2 to 5—358,781 cubic feet. ,, 6 to 8—279,817 ,,
		RS. A. P.	RS. A. P.
	"Felling and logging (cost of compartments finally felled) rent of leased land."—		
2	Felling and logging (cost of compartments finally felled) rent of leased land ..	0 0 8·6 per cubic foot.	0 0 5·40 per cubic foot.
3	Dragging and carting (including maintenance of live-stock)	0 2 9·9 ,,	0 1 6·97 ,,
4	Overhead charges	0 4 3·3 ,,	0 3 0·09 ,,
5	Total cost of extraction to river bank	0 7 9·8 per cubic foot.	0 5 0·46 per cubic foot.
		RS. A. P.	RS. A. P.
6	Rafting and floating	0 2 5·05 per cubic foot	} 0 3 8·71 per cubic foot.
7	Loss on bamboos	0 0 8·47 ,,	
8	Tanah expenses	0 0 0·28 ,,	
9	Depot expenses	0 0 9·20 ,,	No rate quotable as costs were apportioned separately to the various kinds of transactions. The depot expenses are considerably higher than in 1925–26, as a heavy charge is borne on account of the Forest Utilization Officer, his establishment and superior officers.
10	Total cost of production ..	0 11 8·80 per cubic foot.	

NOTE.—The decrease, in 1926–27, in columns 2 and 3 is chiefly due to the fact that a much greater proportion of the outturn was from plantation final fellings, where felling and extraction is cheaper than in natural forests.

121. *Current or recent exploitation rates.*—The rates given in the following tables are those in force in 1926–27 or 1927–28. In these years, exploitation of natural forests has been practically confined to the Amarampalam Range, so no rates are given for the Nilambur Range. They should, however, be less than in the Amarampalam Range, and the same is the case with almost all works. Thinnings were suspended during 1925–26, and were only re-commenced late in 1926–27. The only figures of costs available at the time of writing are for a single plantation in the Amarampalam Range, where the work was done on daily wages. Rates have been calculated by dividing the cost of each operation by the actual outturn extracted; the total cost of marking and felling therefore includes charges on IV, V and VII class poles which were felled and left in the forests, as being unprofitable to extract. It has already been remarked that most, if not all, of the exploitation rates can and should be reduced. The cost of floating, on contract, from the Nilambur Range is the most outstanding example of excessive expense, and rates for the supply of bamboos (even admitting that the effect of the last flowering is still felt to some extent) appear to be unreasonably high. The practice of adopting a flat exploitation rate for large groups of different classes of timber or poles is probably disadvantageous to Government.

NILAMBUR RANGE.

Locality exploited.	Work.	Rates.	RS.	A.	P.	
Teak plantations (final fellings).	Final felling and logging.	Short logs	0	3	6	each.
		Logs, all other classes ...	0	4	6	,,
		Measurables ...	0	1	6	,,
		Poles, all other classes (Rs. 5 per 100)	0	0	9·6	,,
	Removing bark at centre, and classifying.	Logs, short logs and measurables	4	0	0	per 100.
	Final classification, chiselling measurements, etc., and checking.	Logs, short logs and measurables	2	8	0	,,
	Cutting drag-holes ...	Logs	2	12	0	,,
	Dragging (i.e., wages of extra labour to assist elephant and buffalo-men).	Logs, short logs and measurables	3	2	0	,,
		Poles all other classes ...	1	0	0	,,
	Bamboos for floating ... (Felling in Government forest and delivery on river bank in Edacode).	From Pokode	7	8	0	per 120.
		,, Pannengode ...	6	6	0	,,
		,, Chatomborai ...	7	8	0	,,
		,, Erambadam ...	9	8	0	,,
		,, Kanakuth ...	8	8	0	,,
		,, Elenjeri, etc. ...	6	0	0	,,
		,, Edacode and Valichapali ...	8	8	0	,,
		,, Old Amarampalam ...	7	14	0	,,
		,, Kariem and Muriam ...	12	0	0	,,
		,, Walluvasseri ...	7	0	0	,,
	Floating from Edacode to Beypore on contract.	Logs Rs. 2 and Rs. 2-12-0 per candy or	0	2	5·5	per cubic foot. and
			0	3	4·6	,,
	Government supplying bamboos and delivering both timber and bamboos at rafting depots.	Poles, measurables ...	1	0	0	each.
		,, Superior small ...	0	7	0	,,
		,, I Class ..	0	9	0	,,
		,, II Class ...	0	7	0	,,
		,, III Class ...	0	6	0	,,
		,, VIII Class ...	1	0	0	,,

AMARAMPALAM RANGE.

Locality exploited.	Work.	Rates.	RS.	A.	P.	
Natural forests (clear fellings).	Felling, logging, dressing and cutting drag-holes.	Logs of miscellaneous species ...	0	0	10	per cubic foot.
	Numbering, measuring and classification.	Logs of miscellaneous species	0	0	0·3	”
	Dragging (i.e.), wages of extra labour to assist elephant men.	Logs of miscellaneous species	0	0	0·5	”
	Carting, $2\frac{1}{4}$ miles ...	Logs of miscellaneous species—				
		In Government carts at Rs. 0-8-0 per candy.	0	0	7·4	”
		In private carts at Rs. 1-8-0 per candy.	0	1	10	”
	Cordage for tying rafts.	Rafts of miscellaneous species	3	0	0	per raft.
	Tying into rafts ...	Miscellaneous species ...	2	0	0	”
	Floating	Miscellaneous species—				
		Nedungayam to checking station ...	4	8	0	”
		Checking station to Beypore	2	8	0	”
	Bamboos for floating— Felled in Government forests and delivered at Nedungayam.	From Padukka ...	10	8	0	per 120.
		” Kallianthodu ...	7	8	0	”
		” Narakadavu ...	10	0	0	”
Teak plantations (thinnings).	Marking for thinning ...	Average for 1,900 plantation (mostly poles) ...	0	0	0·53	per cubic foot.
	Felling and classifying thinnings.	Do. ...	0	0	4·64	”
	Dragging to Nedungayam (wages of extra labour only).	Do. ..	0	0	3·19	”
	Cordage for tying rafts.	Rafts of teak poles ...	4	8	0	per raft.
	Tying into rafts ...	Do. ...	1	4	0	”
	Floating	Rafts of teak poles—				
		Nedungayam to Checking station ...	3	0	0	”
		Checking station to Beypore	1	8	0	”

122. *Exploitation rates in* 1918.—Since the current high costs of extraction are due, in part, to abnormal conditions, and since the existing rates are not sufficiently detailed, the following tables are reproduced ; from Mr. Bourne's working plan.

Statement of cost of extraction per cubic foot.

Item of work.	From plantations by scale classes. — Logs. — Over 8 candies.	6—8 candies.	4—6 candies.	2—4 candies.	Under 2 candies	Short.	Miscellaneous.	Measurables.	Superior small.	Class. — I.	II.	III.	IV.	V.	VII.	VIII.	Rejections.	Natural forests. — Miscellaneous logs.
Nilambur Range.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.	RS.
Clearing lines, marking, etc., or enumeration of final fellings	·0047	·0048	·0049	·0051	·0053	·0053	·0053	·0059	·0059	·0069	·0092	·0108	·0113	·0139	·0108	·0053	·0139	..
Felling	·0070	·0072	·0074	·0076	·0080	·0080	·0080	·0088	·0088	·0104	·0138	·0162	·0170	·0208	·0162	·0080	·0208	·012
Dressing logs	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·060
Cutting drag holes and dragging (exclusive of the cost of elephants)—																		
(1) To riverside depot	·005	·005	·005	·005	·012	·015	·012	·015	·017	·023	·023	·029	·036	·036	·037	·026	..	..
(2) Thence to rafting place	·002	·001	·001	·002	004	·006	·004	·006	·006	·008	·008	·009	·012	·012	·012	·009	..	..
(3) Direct to rafting place	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·122
Hire and maintenance of elephants ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·110
Rafting (1) Tying into rafts	·0085	·0095	·011	·0085	·016	·016	·016	·016	·0085	·0082	·0097	·012	·017	·022	·026	·018	..	·009
(2) Cordage	·045	·050	·058	·045	·083	·083	·083	·083	·045	·043	·051	·063	·088	·117	·138	·094	..	·048
Floating	·026	·028	·033	·026	·048	·048	·048	·048	·026	·025	·029	·036	·051	·066	·078	·054	..	·045
Storing in sale depot	·0035	·004	·005	·007	·012	·010	·012	·010	·004	·006	·008	·014	·026	·043	·018	·006	..	·010
Contingencies	·010	·011	·013	·011	·019	019	·019	·019	·012	·013	·015	·019	·026	·033	·034	·022	..	·031
Total ..	·112	·121	·138	·117	·207	·210	·207	·212	·133	·144	·167	·209	·284	·364	·370	·242	..	·447
Amarampalam Range.																		
Clearing lines, marking, etc.	·0058	·0060	·0061	·0063	·0067	·0067	·0067	·0073	·0073	·0087	·0115	·0135	·0141	·0173	·0135	·0067	·0173	..
Felling	·0087	·0090	·0092	·0095	·0100	·0100	·0100	·0110	·0110	·0130	·0172	·0202	·0212	·0260	·0202	·0100	·0260	·015
Dressing logs	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·075
Cutting drag holes and dragging (exclusive of the cost of elephants)—																		
(1) To riverside depot	·007	·006	·006	·007	·017	·021	·017	·021	·023	·031	·031	·039	048	·048	·049	·035	..	..
(2) Thence to rafting place	·002	·002	·002	·002	·005	·007	·005	·007	·007	·010	·010	·013	016	·016	·016	·014	..	..
(3) Direct to rafting place	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·152
Hire and maintenance of elephants ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	·110
Rafting (1) Tying into rafts	·0085	·0095	·011	·0085	·016	·016	·016	·016	·0085	·0082	·0097	·012	·017	·022	026	·018	..	·016
(2) Cordage	·045	·050	·058	·045	·083	·083	·083	·083	·045	·043	·051	·063	·088	·117	·138	·094	..	·048
Floating	·043	·048	·055	·043	·080	·080	·080	·080	·043	·041	·049	·060	·085	·110	·130	·090	..	·045
Storing in sale depot	·0035	·004	·005	·007	·012	·010	·012	·010	·004	·006	·008	·014	·026	·043	·018	·006	..	·010
Contingencies	·010	·011	·013	·011	·019	·019	·019	·019	·012	·013	·015	·019	·026	·033	·034	·022	..	·036
Total ..	·134	·146	·165	·139	·249	·253	·249	·254	·161	·174	·202	·254	·341	·432	·445	·296	..	·507

N.B.—Cost of works executed on daily wages is based on daily wage per coolie unit of six annas and eight annas in the Nilambur and Amarampalam Ranges respectively.

Schedule of rates for payment for work on contract.

Item of work.	From plantations by sale classes.																		From natural forests.	
	Logs each.							Poles each.									Spokes and felloes per set.		Bamboos per 100.	Miscellaneous logs per cubic foot.
	Over 8 candies.	6–8 candies.	4–6 candies	2–4 candies.	Under 2 candies.	Short.	Miscellaneous.	Measurables.	Superior small.	I	II	III	IV	V	VII	VIII	First class	Second class.		
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Nilambur Range— Felling ..	0 13 6	0 10 6	0 7 9	0 4 9	0 1 8	0 0 8	0 1 8	0 1 0	0 0 8	0 0 7	0 0 6	0 0 5	0 0 4	0 0 2	0 0 4	0 0 5	2 8 0	2 0 0	2 0 0	0 0 2
Dragging	..	.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1 4 0	..
Storing in sale depot.	0 6 6	0 6 0	0 5 3	0 4 3	0 2 7	0 1 2	0 2 7	0 1 2	Rs. 19-6-0 per 1,000								..	..	..	0 0 2
Tying into rafts ..	Re. 1-0-0 per raft.																..	..	..	1 0 0 per raft.
Floating, (1) To Pongalur—																				
From up the Punnapuzha.								1 2 0 per raft.												
From up the Chaliar.								1 2 0 ,,												
From up the Kanhirapuzha.								1 4 0 ,,												
From Edacode 1891 and 1892.								1 6 0 ,,												
From up the Kuruvampuzha.								1 4 0 ,,												
From Old Amarampalam.								1 12 0 ,,												
From up the Mundayanthodu.								0 14 0 ,,												
From Punnapuzha mukku.								1 0 0 ,,												
From Chaliar mukku.								0 12 0 ,,												
From Kuruvampuzha mukku.								0 8 0 ,,												
From Mundayanthodu mukku.								0 3 0 ,,												
Average ..								1 0 3 ,,												
From natural forests. (2) To Chaliar mukku.																				3 12 0 per raft.
From Amarampalam Range.																			1 4 0	
(3) To Kuruvampuzha mukku.																				
From Amarampalam Range.																			1 12 0	
From Kanakuth, etc.																			0 12 0	
From Edacode, etc. ..																			0 6 0	
(4) To Beypore .. From Pongalur								1 4 0 ,,												1 4 0
Average total ..								2 4 3 ,,											4 2 0	5 0 0

Schedule of rates for payment for work on contract—*cont.*

Item of work.	From plantations by sale classes.																		From natural forests.	
	Logs each.							Poles each.									Spokes and felloes per set.		Bamboos per 100.	Miscellaneous logs per cubic foot.
	Over 8 candies	6-8 candies.	4-6 candies.	2-4 candies.	Under 2 candies	Short.	Miscellaneous.	Measurables.	Superior small.	I	II	III	IV	V	VII	VIII	First class.	Second class.		
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Amarampalam Range—Felling	1 0 3	0 13 0	0 9 7	0 5 11	0 2 1	0 0 10	0 2 1	0 1 3	0 0 10	0 0 9	0 0 8	0 0 6	0 0 5	0 0 3	0 0 5	0 0 6	3 2 0	2 8 0	3 8 0	0 0 3
Dragging. (1) Except Nellicutta.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	3 8 0	..
Dragging. (2) Nellicutta.	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1 4 0	..
Storing in sale depot ..	0 6 6	0 6 0	0 5 3	0 4 3	0 2 7	0 1 2	0 2 7	0 1 2	Rs. 19-6-0 per 1,000.								..	..	..	..
Tying into rafts ..	Re. 1-0-0 per raft.																..	..	..	1 12 0 per raft.
Floating	RS. A. P.																			
(1) To Chanakundu mukku. From Nedangayam, etc.	0 8 0 per raft.																			
(2) To Chaliar mukku. From Chanakundu mukku or Nellicutta.	1 10 0 ,,																			
(3) To Mundayanthodu mukku. From natural forests ..																				3 8 0 per raft.
(4) To Pongalur .. From Chaliar mukku ..	0 12 0 ,,																			
From Mundayanthodu mukku.																				0 4 0 per raft.
(5) To Beypore .. From Pongalur ..	1 4 0 ,,																			1 4 0
Average total ..	4 2 0 ,,																		5 14 0	5 0 0

N.B.—(1) All the above works which may be paid on contract require skilled labour and the rates shown allow of coolies earning from 6 annas to 12 annas per day in the Nilambur Range and 8 annas to Re. 1 per day in the Amarampalam Range according to their own inclination.

(2) Owing to the great difficulty and consequent delay in floating rafts on the fall of the water level in the rivers, the rates for floating in any one each of the river should be doubled from a date to be fixed annually by the District Forest Officer. In the Nilambur Range such dates will generally be about 15th October in the smaller rivers and 15th December in the main river. In the Amarampalam Range such dates will generally be about 15th October between Nedungayam, Nellicutta, etc., and Chaliar mukku and 15th December below Chaliar mukku.

Section 6—Past and current prices.

123. *General.*—Since the earliest sales, about the year 1860, there has been a gradual rise in price for almost all classes of timber, up to the year 1914. During the war prices rose sharply, and this inflated level of values was maintained, more or less, till 1920. In the latter year there was a marked general decrease, and this was accentuated in 1921 owing to the Malabar rebellion. In 1922, prices improved somewhat, but did not generally reach the 1920 level and a steady decline continued till 1925. The lowest point was touched about this time. The general fall in prices, from 1920 onwards, is attributable to the re-action from the temporary prosperity which most trades enjoyed during the war. Most prices improved considerably in 1926, and it is satisfactory to note that the 1913–14 level was reached, and sometimes exceeded, in 1926–27, for most of the classes of plantation teak, and for several species of miscellaneous timber. At the time of writing, the upward tendency of prices continues, for nearly all produce. Large quantities of Terminalia paniculata logs have been sold in recent auctions for about Rs. 1–4–0 per cubic foot (a price which has practically never been touched in the past), and this is a matter for congratulation, when it is remembered that most of the outturn from natural forests consists of this species. Prices for the smaller classes of teak poles have not undergone such fluctuations as in the case of timber, but there has been much variation in the demand, and it has often been impossible to sell them at all. Rates realized on the coast are almost invariably higher than those obtained in local sales, but in recent years the difference has occasionally been less than the cost of extraction. The question is not stressed one way or the other, for the marketing of the timber is now in the hands of a special branch, whose function it is to find the best market. With the advent of the railway, however, and the proposed increase in exploitation, it is the writer's personal belief that there will be considerable possibilities for local sales, or for railing of timber direct from Nilambur. The sale of standing timber must also be considered, for it may not be possible for Government to cope with all the extraction work, and further, unless Government costs of extraction decrease considerably, or prices appreciate a lot, junglewoods are unlikely to realise any profit unless sold locally.

124. *Prices of plantation teak.*—Long straight logs fetch the highest prices. For their size, it appears that the best prices are obtainable for the logs of 2 to 4 candies; in other words the present market demand for larger timber is inconsiderable, though the possibility of finding special markets for very big stuff must not be left out of consideration. The timber should be reasonably free from traces of epicormic branches, though there appears to be little fall in price except in the case of logs which are obviously very knotty. Mr. Bourne's experience of the coastal market was that the teak timber lost nearly half its value, unless sold green. Recent experience in handling girdled teak has shown that there is little or no difference in the prices paid for green, and for seasoned timber. Without further test, however, this statement must be taken with caution. As regards poles, it is certain that they must be sold as soon as possible after felling, if their proper value is to be realized. The first of the following statements shows the average rates realized at all sales in Beypore and Kallai, for the past 21 years. The second statement gives the average prices obtained at local sales, either in river-side or road side depots, or, occasionally, in the coupes. All rates are given in rupees, and are for the cubic foot, unless otherwise stated. Prices for sleepers are not given, as the writer has no information of the quantity which was rejected and sold at low prices.

Statement of average rates of all sales at Beypore and Kallai from 1906-07 to 1926-27.

Sale class.	Average rates in rupees per cubic foot.																				
	1906-07.	1907-08.	1908-09.	1909-10.	1910-11.	1911-12.	1912-13.	1913-14.	1914-15.	1915-16.	1916-17.	1917-18.	1918-19.	1919-20.	1920-21.	1921-22.	1922-23.	1923-24.	1924-25.	1925-26.	1926-27.
Logs above 10 candies ..	..	..	..	..	..	..	..	..	..	..	..	4·38	4·44	3·81	5·48	..	..	2·93	..	..	2·26
Logs 8 to 10 candies ..	..	..	..	..	..	..	..	..	..	..	..	4·15	5·78	4·70	5·50	..	..	2·39	..	..	2·56
Logs 6 to 8 candies	..	..	..	..	..	..	..	..	..	..	4·81	4·96	5·87	4·57	3·76	2·99	..	2·61	..	2·73	2·52
Logs 4 to 6 candies	..	..	..	2·27	2·52	2·11	2·70	2·54	3·02	2·90	3·15	4·27	4·99	3·83	3·17	2·43	3·08	2·28	2·34	2·28	2·53
Logs 2 to 4 candies	2·21	1·97	2·50	1·69	1·59	1·71	1·88	2·32	2·52	2·50	2·94	3·39	3·52	3·05	2·73	2·25	2·35	1·97	1·93	1·84	2·28
Logs under 2 candies	1·31	1·50	1·39	1·32	1·31	1·24	1·43	1·54	1·64	1·68	2·02	1·63	1·71	1·78	2·05	1·46	2·14	1·64	1·90	1·17	1·90
Short logs	..	0·88	1·13	1·16	1·19	1·29	1·02	1·22	2·05	1·51	1·41	1·86	2·27	2·44	2·20	..	2·01	1·33	1·26	1·56	1·48
Measurables	1·08	1·02	0·97	0·51	0·91	1·04	0·96	0·91	1·16	1·24	1·32	1·19	7·89	9·22*	9·07*	7·21*	9·65*	9·97*	8·05*	7·26*	6·77*
Superior small	0·67	0·57	0·58	0·46	0·47	0·48	0·49	0·53	0·99	0·85	0·59	0·80	0·75	0·87	0·76	0·73	0·27	0·80	0·75	0·77	0·86
First class	0·49	0·50	0·50	0·27	0·38	0·46	0·43	0·46	0·67	0·62	0·70	0·57	0·68	0·80	0·66	0·63	0·34	0·60	0·51	0·36	0·53
Second class	0·43	0·46	0·51	0·60	0·54	0·62	0·42	0·54	0·65	0·40	0·43	0·51	0·53	0·64	0·61	0·43	0·42	0·43	0·47	0·40	0·52
Third class	0·54	0·58	0·71	0·80	0·80	0·89	0·94	0·72	..	0·40	0·43	0·46	0·38	0·64	0·53	0·45	0·38	0·34	0·43	0·38	0·39
Fourth class	0·50	0·33	0·38	0·42	0·50	0·50	0·46	0·40	..	0·33	0·42	0·36	0·39	0·58	0·51	0·44	0·48	0·42	0·38	0·53	0·31
Fifth class	0·42	0·35	0·34	0·36	0·33	0·42	0·21	0·34	0·30	0·48	0·47	0·30	..	0·65	0·54	0·41	0·17	..	..	..	..
Seventh class	0·09	0·30	0·16	0·19	0·26	0·26	0·35	0·20	0·22	0·18	0·23	..	0·28	..	0·62	..	..	..	..	0·45	..
Eighth class	0·44	0·53	0·42	0·40	0·41	0·48	0·43	0·54	1·65	0·79	0·86	1·05	0·71	0·97	1·26	1·18	0·25	0·75	0·71	0·98	1·04
†Spokes and felloes (First class).	..	..	..	..	..	..	..	..	..	..	..	10·00	9·50	11·84	..	..	..	..	..	..	..
Teak scantlings	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	2·80	1·46	5·21
‡Teak reepers	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	20	20
Teak planks	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	4·44	3·99
§Saw-dust	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1·30	1·31

* Each. † Per set. ‡ Per 1,000 running feet. § Per ton.

Statement of average ratès of all local sales from 1918–19 to 1924–25.

Sale class.	Average rates in rupees per cubic foot.						
	1918–19.	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.
Logs 4 to 6 candies	..	..	..	..	2·31	..	..
Logs 2 to 4 candies	..	2·95	..	..	1·92	1·73	2·25
Logs under 2 candies	..	.	1·63	..	1 31	..	..
Short logs	..	1·50	..	..	1·48	..	1·28
Measurables *	..	..	..	..	5·36	8·78	10·38
Superior small	..	..	..	..	0·34	..	0·86
First class	..	..	..	..	0·29	..	..
Second class	..	0·45	..	.	0·15	0·68	..
Third class	..	..	..	..	0·24	0·58	0·66
Fourth class	..	..	..	..	0 17	..	..
Fifth class	..	..	..	..	0·13	..	..
Seventh class	..	..	..	..	0 05	0·10	0·10
Eighth class	..	..	..	..	0·32	0·68	1·16
Spokes and felloes †	8·82	..	9·69	..	..	10·50	11·38
Top-ends *	0·24	0·13	0·13	..	..	..	..

Each. † Per set, for right of conversion.

125. *Prices of timber and bamboos from natural forests.*—The first of the following statements is taken from Mr. Bourne's working plan. As the extraction of natural forest timber in the past was usually small, he based the table partly on departmental sales and partly on rates ruling in the Kallai timber market. The second statement contains the average rates obtained at all departmental sales in Beypore and Kallai, from 1918–19 to 1926–27. The third statement contains the same information for all local sales of felled timber and bamboos, while the fourth table refers to sales of standing timber and bamboos. Mahogany, though not a natural forest timber, is included, for convenience, in the above statements. Prices for this species have usually been very low, but Re. 1 per cubic foot was obtained in a recent auction, for a small lot, and fair prices may be expected when the timber is known in the market. The last statement refers to shipments of selected timber to London, from which it is seen that the rosewood, and most of the Terminalia tomentosa realized a handsome profit.

Statement showing average Beypore or Kallai markét rates of timber from natural forests.

Species.	Malayalam vernacular name.	Average rate in rupees per cubic foot.				Selected logs rate per cubic foot in 1919–20.
		1896.	1903–04.	1913–14.	1919–20.	
Bamboos per 100	Molla	7	4	9·6	..	..
Teak	Tekku	1·9	2·2	2·5	3·0	4·5
Rosewood	Vetti	1·2	2·7	2·7	..	5·0
Lagerstrœmia microcarpa	Ventekku	0·6	1·1	1·2	1·2	2·0
Xylia xylocarpa	Irul	0 6	0·7	1·1	1·2	2 0
Terminalia tomentosa	Karumaruthu	0·6	0 9	1·3	1·5	1·75
Calophyllum tomentosum	Punna	..	..	0 9	..	1·5
Diospyros Ebenum	Karimaram	..	..	3·8	..	..
Dysoxilum malabaricum	Vellagile	..	1·5	1·7	..	4·5
Pterocarpus Marsupium	Venga	·6	1·1	1·3	..	..
Artocarpus hirsuta	Ainee	..	1·0	1·3	..	2·0
Cedrela Toona	Chonagile	..	1·0	1·2	..	1·75
Hopea Parviflora	Irumbogum	..	1.7	1·7	..	2·25
Mesau ferrea	Bainavu	..	..	1·3	..	1·75
Terminalia paniculata	Poomaruthu / Vellamaruthu	Unsaleable	0·6	0·8	1·2	1·5
First class jungle woods *	•	do.	0·6	0·8	..	..
Second class do. †	..	do.	0·4	0·5	0·5	..
Third class do. ‡	..	do.	0 3	0·3	0·4	..

* Including Adina cordifolia, Veembu ; Canarium strictum, Kalpayin ; Dichopsis elliptica, Pali ; Hardwickia pinnata, Chonapayin ; Lagerstrœmia Flos-Reginæ, Nir Ventekku ; Machilus macrantha, Kollirmavu ; and Michelia Champaca, Champakam

† Including Albizzia odoratissima, Vaga ; Bombax malabaricum, Poola ; Dipterocarpus indicus, Velayani ; Grewia tiliæfolia, Chadachi ; Miliusa velutina, Kanakaitha ; Schleichera trijuga, Puvam ; Terminalia belerica, Thani ; and Vateria indica, Vellapayin.

‡ Including Tetrameles nudiflora, Cheeni.

N.B.—Several of the so-called jungle woods fetched very high prices during the war. The prices, however, varied so much from day to day that no attempt has been made to show such species separately.

Statement of average rates of all sales of natural forest timber at Beypore and Kallai from 1918–19 to 1926–27.

Species and description.	Rates in rupees per cubic foot, unless otherwise stated.								
	1918–19.	1919–20.	1920–21.	1921–22	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.
Bamboos *	9·28	12·01	11·61	3·58	11·99	10·02	10·51	7·24	5·63
Teak logs	..	..	1·36	1 39	..	..	..	0·73	1·41
Rosewood logs	1·00	1·53	1 88	1 44	..	..	1·02	2·47	1·50
Lagerstroemia microcarpa logs ..	1·47	1·14	1·16	0·92	..	0·78	0 75	1·11	0·60
Xylia xylocarpa logs	..	1·26	1·23	1·39	..	..	1·02	1·12	0·91
Terminalia tomentosa logs ..	..	1·18	1·14	1·27	1·18	..	0·93	1·05	1·20
Terminalia tomentosa planks ..		..	..	..	..	..	..	3·23	..
Terminalia tomentosa scantlings	..	..	..	..	..	..	..	2·73	..
Terminalia paniculata logs ..	..	1·02	1·03	0·93	0·54	..	0·67	0·77	0·95
Terminalia paniculata reepers † ..	..	..	..	..	..	..	..	15·00	..
Terminalia paniculata scantlings..	..	..	..	..	..	..	..	2·50	.
Terminalia paniculata planks ..	..	..	..	..	..	..	..	3·04	..
Swietenia macrophylla logs ..	0·67	0·50	0·48	..	0·49	..	..	..	..
Junglewood logs	0·65	0 42	0·53	0·54	0·46	0·02	0·36	0·47	0·25

* Per 120. † Per 1,000 running feet.

Statement of average rates for all sales of natural forest timber in river-side, road-side and forest depots.

Species and description.	Rates in rupees per cubic foot for timber ; in rupees per 120 for bamboos.								
	1918–19.	1919–20.	1920–21.	1921–22.	1922–23	1923–24.	1924–25.	1925–26.	1926–27.
Bamboos	.	..	..	..	6·60	3·06	12·59	4 80	..
Teak logs	..	..	..	..	0·73	..	..	..	0·93
Rosewood logs	1·00		1·72	..	0·92	1·00	..	..	1·03
Lagerstroemia microcarpa logs ..	..	0 63	0·77	..	0·57	0·18	..	0·52	0 40
Xylia xylocarpa logs	0·75	0·46	0·92	..	0 65	..	..	0·71	0·48
Terminalia tomentosa logs ..	1·00	0·13	..	..	0·66	..	..	0·69	0·71
Terminalia paniculata logs ..	..	0 63	..	..	0·42	..	..	0·96	0·35
Swietenia macrophylla logs ..		0·34	..	..	0·35	1·30	0·31	0·33	..
Junglewood logs	0·14	0·63	0·31	..	0·17	0·23	0·13	0·17	..

Sales of natural forest standing timber and bamboos.

Species and description.	Flat rates in rupees per cubic foot for the outturn as measured after felling by contractors. Seigniorage rates in rupees per 120 bamboos.							
	1918–19.	1919–20.	1920–21	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.
Bamboos	4·64	4·27	5·41	..	1·19	4·81	..	4·80
Teak	..	..	..	..	..	0·78	..	..
Rosewood logs	..	..	1·00	..	..	0·60	..	..
Lagerstroemia microcarpa logs	0·13	..	0 44	..	..	0·35	..	0·25
Xylia xylocarpa logs	0·13	..	0 44	..	..	0·32	..	0·25
Terminalia tomentosa logs	..	..	0·44	..	..	0·42	..	0·25
Terminalia paniculata logs	0·13	..	0 44	..	0·25	0·26	..	0·25
Junglewood logs	0·13	..	0·13	..	..	0·16	..	..

Sales in London.

Species and description.	Rates in rupees per cubic foot.					
	Year of shipment.	Quantity sold in cubic feet.	Prices realized.	Cost of extraction, transport and handling charges including overheads.	Net profit.	Net loss.
Terminalia tomentosa logs	1921	167	1·95	2·87	..	0·92
Teak planks	1923	458	4·17	3·14	1 31	.
Lagerstroemia microcarpa logs	1923	356	2·33	1·86	0·47	
Do.	1923	922	1·55	1·86	..	0·31
Terminalia tomentosa logs	1924	1,339	5·00	2 25	2·75	..
Do.	1924	490	4·78	2·33	2·44	..
Do.	1924	432	6·56	2·15	4·41	..
Rosewood logs	1926	608	11·17	3·43	7·73	..

126. *Minor forest produce.*—With the exception of canes, all items of minor produce are sold together, on an annual lease, for each range separately. The produce is collected and removed by purchasers. The following are the amounts realized since 1915–16 :—

Year of lease.	Nilambur range lease amount.			Amarampalam range lease amount.		
	RS.	A.	P.	RS.	A.	P.
1915–16	...			1,075	0	0
1916–17	...			810	12	0
1917–18	75	0	0	1,095	0	0
1918–19	75	0	0	975	0	0
1919–20	75	0	0	831	0	0
1920–21	100	0	0	1,040	0	0
1922–23	135	0	0	1,350	0	0
1924–25	170	6	6	1,375	0	0
1925–26	100	0	0	805	0	0
1926–27	310	0	0	1,100	0	0

The right of collecting canes has only been sold twice in recent years. The leases apply to the new Amarampalam reserve. The following amounts were realized :—

Year of lease.	RS.
1920–21	200
1922–23	1,200

CHAPTER IV.—STAFF AND LABOUR SUPPLY.

SECTION 1—THE FOREST STAFF.

127. *Present strength.*—The following table shows the present strength and distribution of the executive and clerical establishment for the area covered by this working plan:—

Establishment of	Gazetted officers.	Rangers.	Assistant Veterinary Inspector.	Foresters.	Forest guards.	Watchers.	Checking officers.	Clerks.	Peons, office watchers and gardeners.
District Forest office.	Deputy Conservator 1, Extra Assistant Conservator 1.	..	1	1 * (for defoliation research work).	..	..	..	6 5 *	Peons 4, peons 2 *, office watchers 1 *, gardener 1 *
Nilambur range.	..	3 (of which 1 is Supernumerary).		8 3 *	17	Reserve watcher 1 *, tana watcher 1 *, bungalow watcher 1 *.	1 * (Pandicad tana).	1 2 *	Peon 1 *.
Amarampalam range.	..	2 (of which 1 is supernumerary).	..	6	14	Reserve watchers 4 *, bungalow watcher 1 *.	..	1 1 *	Peon 1 *, tappal runner 1
Total ..	2	5	1	14 4 *	31	8 *	1 *	8 8 *	4 7 *

Note.—Temporary posts are marked *.

From the above table, it is seen that 93 posts (permanent and temporary) are filled. The following sanctioned posts are vacant :—Foresters, permanent, two, while the two supernumerary rangers remain unabsorbed in the cadre of rangers ; forester, temporary, for the year 1927–28, one ; elephant jamadar, temporary, one.

The suitability of the existing establishments of the District Forest office and of the ranges, for present and future requirements, is discussed in the following paragraphs.

128. *District Forest office.*—It is always essential that the District Forest Officer should have at least one gazetted assistant. The forester who works directly under the District Forest Officer is required in connexion with the defoliation investigations of the Imperial Entomologist, and the other posts, excluding the clerical staff, call for no comment. Prior to 1924, the District Forest office staff consisted of nine clerks, of which three were temporary. With the introduction of the commercial system of accounting in 1924, the clerical staff was increased by two temporary posts, a commercial accountant on the time-scale of 60—4—80, and his assistant on Rs. 35 a month, bringing the total number of posts to 11. The whole of this staff is fully employed at present, in fact it is overworked. It is probable, however, that the commercial accounts system will be abolished shortly. If such is the case, the posts of commercial accountant and of commercial accounts assistant will not be required. Further limitation of the office staff is impossible, if the work is to be conducted efficiently. It is undesirable that so many of the clerical posts should be temporary.

129. *Nilambur and Amarampalam Ranges.*—The Nilambur Range Officer has two assistant rangers, and the Amarampalam Range Officer has one. All are necessary, but it is not desirable to give them titles, as has been done in the Nilambur range, (e.g. 'Regeneration Ranger'). Any recognition of 'specialists' tends to lessen the responsibility of the Range Officer. The latter should have his assistants to employ on current works as he thinks fit, and when he knows that his is the ultimate responsibility in all matters affecting his range, he will see to it that his assistants give satisfaction. Sixteen foresters are required for the ordinary work of both ranges. The present checking officer at Mundayanthodumukku (on the Chaliar river) is a temporary Forester, but the post is a responsible one, requiring a man of higher standing and greater tact. An elderly ranger of moderate ability would be a more suitable incumbent. The Pandicad tanah (checking station), though still maintained by the Nilambur Division, is now within the territorial jurisdiction of the District Forest Officer, Palghat. It should be taken over by the latter, and the post of checking officer, sanctioned in the establishment of the District Forest Officer, Nilambur, should be retained for the employment of a checking officer in a new checking station to be established at Nilambur. This is necessitated by the opening of the Shoranur-Nilambur Railway. It is inadvisable to continue without a jamadar, for though the Foresters now in charge of elephants are useful men, the work of training new captures, and of acting for the Assistant Veterinary Inspector in emergencies, may sometimes prove too much for them, in addition to their usual duties. No other changes are contemplated at present. The adequacy of the existing staff for the execution of the revised working plan will be tested in actual practice.

130. *Quality of the subordinates.*—Frequent changes of officers, in the Division and in the Nilambur Range, have re-acted unfavourably on the work of the Foresters and Forest guards. Further, the scattered nature of the work in Nilambur Range of recent years has prevented adequate supervision of the work of the subordinates. In the Amarampalam Range the position has been more satisfactory. On the whole, the Foresters are of average ability, and many of them have long experience of the work they have to perform. The Forest guards are mostly men who have been recruited from the ranks of the old permanent labour force, and as it often happens that a guard is related to some of the coolies of whom he is in charge, it follows that he does not always get the most out of his labourers. This disadvantage is, however, compensated to some extent by the fact that such Forest guards are in intimate touch with the source of the local labour. Practically all the subordinates are natives of Nilambur and its neighbourhood, and given more satisfactory conditions as regards the tenure of office of their superiors, and a more concentrated arrangement of forest works, they should give no cause for complaint in the future.

SECTION 2.—LABOUR SUPPLY.

131. *General description of the labour position.*—As an essential preliminary to the expansion of forest work which he prescribed, Mr. Bourne, in his working plan of 1918, provided for the recruitment of 300—400 coolies to supplement the local labour supply. (The latter then consisted of 100 to 200 men, according to the season of the year.) But no special measures have been taken in this direction, and actually the labour situation has got steadily worse since 1918. There are far fewer regular

coolies now, and as far as the Nilambur Range is concerned, their work is of the poorest quality. There are a number of reasons for the present unsatisfactory state of affairs. In the first place there is no doubt that constant changes of Range Officers have had a marked effect, for while the number of regular coolies now available in the Nilambur Range is less than half of what it was in 1918, the number has, if anything, increased in the Amarampalam Range, and this difference must be due, almost entirely, to the fact that an efficient Ranger, a native of the Ernad taluk, has been in continuous charge of the Amarampalam Range for the past six years, whereas the charge of the Nilambur Range has changed hands repeatedly. From 1924 onwards, most of the floating has been done on contract, and numbers of good Government coolies have gone to the floating contractors, where they can make more money, and most of them have been lost to the Forest department thereafter. At the end of 1924 the construction of the Shoranur-Nilambur Railway commenced to attract labour from all sides, and about the same time wholesale exploitation in local private forests was started, and the last of the good Government coolies then deserted, to their own advantage. The railway is now open, and constructional work is nearly completed, so the labour position will soon be somewhat easier. But it will be an uphill task to regain the lost ground in the first place, and then to increase the permanent labour force.

132. *Nilambur Range.*—The factors contributing to the unsatisfactory state of the labour supply in the Nilambur Range have been detailed in the preceding paragraph. At the time of writing, the Range Officer can count on no more than 30 coolies a day (including women and boys) for regular work, and they are the very worst of the local labouring classes—of poor physique, lazy and unreliable; in fact they are the 'unemployables' of Nilambur, for private employers will have nothing to do with them, and they are very wise. The maximum number of coolies which turned out in a day, during the 1927 planting season, was 110, although the planting season is not a busy time for agricultural work. Felling coolies can always be obtained, as the work is attractive and well-paid. All the labour is local, with the exception of special workers such as sawyers, masons, etc.

133. *Amarampalam Range.*—About 35 men are employed regularly throughout the year. From the middle of May till the middle of July about 150 additional coolies (including women and children) are available. In August, September and October not more than 50 coolies in all can be obtained, which makes it difficult to conduct weeding operations at the proper time. The coolies work reasonably well, in fact when it is realized that much of the recent work has been so far from their homes that many of them have had to walk 10 miles, to and fro, criticism seems out of place. Most of the coolies live in the neighbourhood of Karulai, though some Naickens from Nedungayam, Mundakadavu, etc., are also employed. There has been no need, as yet, to muster much labour for work at Nellikutta, but it is thought that about 50 local coolies a day can be had during slack seasons in the fields. In this range, as in the Nilambur Range, there is never any difficulty in getting axemen.

134. *Wages.*—In 1917 the wages for male coolies, for ordinary work, were raised to As. 5–6 a day in the Nilambur Range and to As. 6 in the Amarampalam Range. The highest wage paid in the last decade, for ordinary work, was As. 7. In the present year (1927) the wages for ordinary work are the same in both ranges, and vary from As. 4 a day for small boys to As. 6 a day for the best male coolies. Women are usually paid As. 5. For special works, such as the execution of thinnings, Loranthus clearing, etc., the wages are As. 6–6 to As. 7, depending on the quality of the individual coolies employed. In the 1927 regeneration season, coolies from the neighbourhood of Karulai, in the Amarampalam Range, were got to live at Mundakadavu for about 10 days at a time, and were paid at the rate of As. 8 a day. The increased work turned out by this arrangement resulted in a gain to the department as compared with the work which would have been performed for As. 6 a day had the coolies walked from and to their homes daily. For final fellings in the old plantations at Nilambur, coolies employed on daily labour are paid As. 8 a day. Clear-felling in natural forests is usually done on contract, and the rate, in the Amarampalam Range, has recently been reduced to 9 pies a cubic foot, including the dressing of logs and cutting drag-holes. The rate for selection fellings in remote parts of the forests will probably exceed this figure, but should not rise

above 1 anna per cubic foot. Carpenters are paid As. 14 to Re. 1 a day. Works such as rafting and floating (when done departmentally) collection of bamboos, etc., are performed on piece-work contract, and are dealt with in another chapter. When coolies are taken away from their homes (whether within or without the range in which the work is to be done) higher wages will always have to be paid.

CHAPTER V.—PAST SYSTEMS OF MANAGEMENT.

SECTION 1.—GENERAL HISTORY OF THE FOREST.

135. *Sources of information.*—The history of the forest, from 1828 to 1918, has been taken from Mr. Bourne's working plan and control records. The detailed history of each compartment, from 1918–19 to 1927–28, has been compiled from works registers, annual reports, control forms, personal knowledge, and local verbal information. Owing to the destruction of records in the rebellion of 1921, and to the inordinate delays and inaccuracies in posting the control forms, it is realized that there are minor inaccuracies and deficiencies in the revised compartment histories. It is believed, however, that all important details of history have been recorded. The general history, for the last decade, is thought to be complete and accurate.

136. *Reason why all the forests are leased, or have had to be purchased.*—All forests and other unoccupied lands in the old province of Malabar have been considered to be private property. Considering the present devastated state of vast areas of accessible forests, this decision can only be lamented. The civil courts of Madras and Bombay have long ago made it law. Volumes have been written on land tenure in Malabar, and anyone, who is further interested in this question, can refer to them. Nevertheless, the province of Malabar is conquered territory, wrested from Tippoo Sultan in 1792, and, if the practice, often followed in other parts of India, had been adopted here, the forests would have been held by the State in common trust for the people. Though formally taken possession of from Tippoo, no steps were taken to exercise the right of possession. This was due to the unsettled state of the country and the attention of the authorities being centred on quelling risings of the Mappillas (Moplas) and settling disputes between neighbouring Rajas. The large landowners in the vicinity of the forest took possession of them. Whether they were in possession of all of them prior to Tippoo's conquest of Malabar is questionable. At least they laid claim to them and carried on or permitted fellings to be carried on in them. The subsequent attitude of the Directors of the Most Honourable East India Company on this question is clearly defined in the following extract, taken from a Despatch to the Governor-General in India, dated the 30th of November 1842 : 'In the time of the ancient Rajas the forests were held as private property. They were indeed seized by Tippoo Sahib after his conquest of the country (1766) and after its cession to the Company, they were taken possession of on behalf of the latter, but having now for many years been abandoned to the original proprietors, it would be no less unjust than impolitic to revive a claim to them, which seems never to have had any other foundation than Tippoo's usurpation.' The result, in the present day, is that Government is in possession of an infinitesimal proportion only of the total area of forest lands within the old province of Malabar.

137. *How some forests came to be leased by Government.*—As has already been stated, the forests, covered by this working-plan, have either been leased or purchased outright. Some forest lands were escheated to Government and, though they are not covered by this working-plan—in fact the greater part of them are no longer in this Division—some reference to them is necessary since they constituted the sole area of forest in the possession of Government prior to 1840. At that time the forests of Kanara and Malabar were the source of the teak timber required for the Bombay Naval Dockyard. The felling of teak went on so rapidly that the authorities in Malabar became extremely anxious as to the permanency of the supply. So far back as 1828, Mr. Sheffield, then Principal Collector in Malabar, drew the attention of Government to the wanton destruction of young teak, proposing a total prohibition on the felling of such trees. Nothing, however, was done until 1840, when Mr. H. V. Conolly, the Collector of Malabar, brought to the notice of Government the inaccessibility of the Government escheat lands, their small extent, the poor quality of teak timber which they contained and the fact that most of the

mature timber had already been felled and removed by Captain Williams, the Government Agent for Naval timber in Malabar. He pointed out the great difficulty, experienced by Captain Williams, in obtaining sufficient teak to supply the annual demand. He estimated the average annual quantity of teak, required for the Public Service at Bombay, on the supposition that one Government vessel would be constantly under construction at the dockyard, at 6,000 candies of 13 cubic feet, or about 2,000 trees. He calculated that to supply this quantity annually would, as the teak tree reaches maturity in about 60 years, require about 120,000 trees, planted in succession. For this purpose, he recommended the acquisition by Government of 260 square miles of forests. As a commencement, he reported that the management of the Trickalayur Pagoda were willing to mortgage their forests to Government, estimated at 50 square miles; that these forests were for the most part situated on the banks of the Nilambur river and contained some of the very best land for teak. These proposals were approved by Government and the Karar (lease) with the Pagoda was executed on the 10th December 1840. On the 15th July 1842, Mr. Conolly informed the Board of Revenue that he had leased a further teak forest of considerable extent, Nellicutta, from the Zamorin Raja of Calicut. This lease was executed on the 10th November 1841. The conditions of these two leases have already been described. The areas of these forests under these two leases, as subsequently ascertained by survey, are slightly over 20 and 5 square miles respectively. During 1841 and 1842, Mr. Conolly negotiated with the owners of other forests for their acquisition by Government, particularly in respect of another forest in the Nilambur valley, estimated at 80 square miles in extent. These proposals, however, were dropped in 1843 for several reasons. Of these, the most important were, firstly, the discovery of considerable teak forests in Kanara and secondly, the fact that Mr. Conolly had succeeded in enforcing a prohibition on the removal of immature teak on the lines advocated by Mr. Sheffield in 1828. In his report to the Board of Revenue, dated 30th November 1843, Mr. Conolly wrote :—"I do not think it advisable for the Government to make any more purchase of land unless under very favourable and peculiar circumstances. So long as immature teak is not cut, it is of little matter to whom the ground on which it grows belongs. The Government may be secure of obtaining it in due season by paying the market value, and this simple mode of procedure is no doubt far preferable to the more complicated one of taking the risk and responsibility of the grower. The only case in which it seems absolutely necessary that the Government should come forward to take the initiative is in the formation of new forests to replace those which have vanished from private carelessness and rapacity—a work too new, too extensive and too barren of early return to be ever taken up by the native proprietor." Further acquisition of forests, covered by this working-plan, did not take place until 1871. The early history up to this date is, therefore, confined to the forests leased from the Trickalayur Devaswam and the Zamorin of Calicut.

138. *First attempts to sow and transplant teak.*—As has been stated above, Mr. Conolly's object in acquiring these forests was to plant teak. On 26th February 1841, he entertained a Mr. H. Smith to undertake the management. After Mr. Smith's inspection of the forests, Mr. Conolly decided to sow teak seed and transplant natural seedlings in the forests lying to the west of Nilambur. These were reported to have been heavily felled over in the past. He also proposed to free, thin out and transplant seedlings in the remaining forests. The works of sowing and transplanting were undertaken during the monsoon of 1842, but were attended with such little success that Mr. Smith's services were dispensed with and one Sergeant Graham was appointed in his stead in October 1842. The difficulty experienced in getting the teak seed to germinate led Mr. Conolly, early in 1843, to consult Dr. Wight, the Superintendent of Cotton Farms, and Monsieur Perrottet, the Superintendent of the Botanical Gardens at Pondicherry, the latter of whom visited the forests with Mr. Bates, the Head Accountant of the Collector's office. These gentlemen made several suggestions, particularly as to the preliminary treatment of the seed. Sergeant Graham also had suggestions to put forward and Mr. Conolly instructed him to try all the methods proposed. In April 1843, however, Sergeant Graham resigned his appointment, although he was offered an increase in salary. He said that he could not stand the discomforts of the life for himself and his family, nor suffer further the indignity of having to take off his trousers before the crowds

on the bank every time that he had to cross the river. Mr. Conolly then entrusted the work to a Sub-Conservator, Mr. Chatu Menon, who remained in charge up till 1862. This change of officers, just at the time when the above experiments were to be carried out, was unfortunate, but Mr. Bates, after some delay, undertook the experiments in Calicut. He succeeded, in raising a considerable number of seedlings and, following the successful method, some thousands of plants were put out in Aravallicava rather late in the year.

139. *Planting out nursery seedlings eventually resorted to.*—This success led Mr. Conolly to carry out considerable clearings, which were planted up in 1844. In his report to the Board of Revenue, No. 123, dated 14th October 1844, he characterized the experiment as at an end and promised a vigorous extension of the operations in the waste forests west of Nilambur. From 1844, in fact, planting of teak was carried out with great success.

140. *Tribute to Mr. H. V. Conolly.*—Such is the history of the origin of these plantations which have suitably been called the Conolly Teak plantations as a tribute to the memory of their founder. With lapse of time and the attraction that they have had for forest officers throughout India and Burma they are now more commonly known as the Nilambur plantations, but the name of Mr. Conolly can never be disassociated from them. Up to the time of his unfortunate death, he, as Collector of Malabar, controlled their management and evinced, as is evidenced by his frequent inspections and reports, the greatest interest in their treatment and extension. The first step in the introduction of systematic forest management in British India, the plantations form to-day, area for area, the most valuable timber forests in the world.

A.—Period 1844—1862.

141. *General.*—The record of the general history from 1844—1862, the period during which Mr. Chatu Menon was in charge of these forests is derived chiefly from the reports of Mr. Conolly, Mr. Chatu Menon, Mr. McIver of the Botanical Gardens, Ootacamund, who thinned the plantations, Doctor Gibson, the Conservator of Forests in Bombay, Doctor Cleghorn who was appointed the first Conservator in Madras in 1857, Mr. Athol MacGregor, I.C.S., who drew up a special report in November 1860, Mr. Grant, I.C.S., and Captain Morgan, Acting Conservator. So far as these reports described the actual system of management they will be dealt with in the second section of this chapter. Apart from this they give details of the actual establishment entertained, records of revenue and expenditure, statements of saplings planted and removed, statements of work done each month, a few odd details referring to particular areas and a general idea of the condition of the forests at the time of inspection. Much of this information finds a place in tabulated statements, etc., but some is of general interest and may be referred to here.

142. *Establishment maintained—Labour available.*—The subordinate establishment entertained almost from the start and throughout this period consisted of one assistant, four overseers, one duffadar and six peons. At the same time permanent coolies were entertained, their number being supplemented at times by temporary hired men. It is clear from the records that Mr. Chatu Menon, with this limited staff, was able to attend only to the extension and tending of the young plantations. In fact, after some time, when the thinnings commenced, he found it impossible to continue the annual extension over the same area as at the commencement. Indeed in 1857, Doctor Cleghorn advocated the temporary curtailment of the new planting in order that the establishment might be concentrated on the works of thinning and pruning. In his report of 1860, Mr. MacGregor, in referring to this point, drew particular attention to the falling off, from 1857 onwards, of the area actually planted. The plantations had not been surveyed but he gauged it from the statement of seedlings planted. Survey shows that the area had actually been reduced, on the average, by slightly more than one-half. Mr. MacGregor attributed this to two causes. In 1856, about one-quarter of the Government labour went over to the Nilambur Tirumalpad and was not replaced; the average number of coolie units employed during a year fell from over 12,000 to under 9,000. Added to this reduction of labour, there was the growing size of the plantations, approximately 1,400 acres at the end of 1857, and the additional works of thinning, etc., which had been commenced from 1852. He pointed out that there was no local labour and that it

had all to be brought from a distance. He recommended the opening of a cart-road from Mambad, four miles to the west of Nilambur, to the foot of the Carcoor Ghat. He had, in fact, aligned a trace, which, from his description, is approximately the main road to-day. He pointed out the great extent of natural paddy land available and hoped that the opening of the road would lead to a great influx of labour. He emphasised the most urgent need of further thinnings, pointing out that, whereas some plantations had been thinned in their 6th and 7th years, there were plantations eight and ten years of age, which had never been thinned at all. This abstract of a part of Mr. MacGregor's report gives a good idea of the difficulties Mr. Chatu Menon had to contend with at first, while the attendant success may serve as encouragement to those who wish to commence concentrated regeneration operations under similar circumstances.

143. *Fellings and other works undertaken.*—Departmental fellings were, at first, confined to the clearing of sites for new planting. The records show that no timber from these fellings was removed. From the description of these forests, west of Nilambur, as waste forests, it is probable that there was nothing saleable. At that time, indeed, practically nothing but teak and rosewood were saleable in the locality. The records, however, show that a small amount of timber was sold standing on Kuttikanam (stump fee) and from the lease accounts it appears that this timber must have been teak and rosewood to the extent of 580 trees. There is no record to show whether these were felled from sites of new planting or from any other part of the forests. The only other fellings carried out within this period were the thinnings in young plantations commenced in 1852. From 1858, the records of work done show that some of the saplings thinned were floated to Calicut for sale. Some of the saplings were also sold at Nilambur. In addition to these fellings, the other works carried out were pruning and firetracing, which appears to have been completely successful, while in 1861 the demarcation of each year's plantation with boundary stones was commenced and completed shortly afterwards.

144. *Great credit due to Mr. Chatu Menon.*—Though the activity during this period was confined to the planting and tending, great credit is due to Mr. Chatu Menon. In spite of hardships, fever and frequent scarcity of provisions, he appears never to have left his plantations and seems to have kept excellent control over his subordinates and labour. He took the greatest pride in the success of these early plantations; in fact the more or less continuous extension of these plantations to the present day is indirectly attributable to his honesty and integrity. It can conclusively be proved that the extensive failure of several fairly recent plantations is due simply to the wastage, not to use a more suitable expression, of the money provided for the early weedings, which are so essential to success in such operations. Had these weedings in the first plantations not been perfectly executed, as they must have been to have given the results seen in the oldest plantations to-day, there can be little doubt but that this great experiment would have died shortly after birth. In 1858, when Lord Harris, the Right Honourable the President of the Company, visited the plantations, he, in recognition of Mr. Chatu Menon's work, ordered the presentation of an ornamental woodman's knife and belt for meritorious service. Later, on his retirement in 1862, Mr. Chatu Menon was granted an honorary pension.

B.—Period 1862—1883.

145. *General.*—This second period in the early history of these plantations coincides with Mr. Ferguson's charge of the Division. He was trained as a forester in England and appointed as an overseer—shortly afterwards to be raised to the Sub-Assistant Conservator grade. With Mr. Ferguson's advent, some attention was paid to the maintenance of records which have been of great value. He opened timber and sapling registers, lease accounts and maintained a district cash account and diary. [These records were destroyed in the rebellion.] The general history for this period is derived partly from the administration reports, but mainly from the reports of various officers: Mr. Ferguson, Captain, later Colonel, Beddome, Conservator of Forests, who prepared a detailed report containing a description of Compartments in 1877, Dr. Cleghorn, Conservator of Forests, and Mr. MacGregor, I.C.S., who prepared a second report in 1873. The points of general interest will be dealt with in the following paragraphs.

146. *Establishment and labour.*—In 1862 Captain Beddome proposed departmental extraction of timber and saplings and the opening of a sale depot at Calicut in order that Government might take full advantage of the market prices prevailing on the Coast, which were much higher than those obtained at Nilambur. This depot was acquired and opened at Kallai in 1863 and a depot clerk and peons appointed. This enterprise met with almost immediate success, for in 1865 it has been noted that there arose a particular demand for the plantation teak saplings from Arabs and merchants from Cutch. This demand has been sustained to the present day. In order to benefit by the particular request for certain sizes of saplings, the records of 1865 show that an elaborate classification of saplings was made and that they were sold accordingly. This classification, with slight modifications, is the same as that employed at the present time. This institution of departmental extraction and the accounts, necessitated by the classification of saplings, greatly taxed the powers of the existing establishment. At the same time, from 1863, elephants were employed in dragging timber and saplings, which till then had been dragged by hand. The elephants at first were obtained from the Commissariat Department at Cannanore, but were subsequently hired locally. The employment of these elephants set free a considerable amount of labour, which enabled Mr. Ferguson to raise, from 1863, the average area planted to that attained prior to 1857. The subordinate establishments, however, were insufficient to supervise the works and, at the same time, to protect the forests. Indeed in 1865, Mr. Ferguson drew attention to the difficulty he experienced, with his limited staff, in protecting the Government forests, the more so as they are situated on the river banks, in scattered blocks, surrounded by private forests. This difficulty has been experienced up to recent times, when an attempt has been made to introduce adequate timber transit rules which would prove a real deterrent against theft. There is, in fact, no question that illicit fellings have gone on in these forests, particularly the natural forests and the more out of the way plantations, since the date of their acquisition. As a result of Mr. Ferguson's representations and Dr. Cleghorn's recommendations for an increase in thinnings and for a further extension of plantations, a considerable addition to the establishment, including a clerk, was sanctioned in 1867. Difficulty was experienced in obtaining a suitable clerk, who would stay at Nilambur, and Mr. Ferguson had considerable trouble with his executive subordinates. Nevertheless, he made no demand for a further increase in staff during this period. In 1873 Mr. Stanborough, a Probationary Assistant Conservator, was attached to the Division and was in direct charge of planting operations in the Old Amarampalam block. He acted for Mr. Ferguson, when the latter went on long leave for one year from 9th May 1874. The only other leave taken by Mr. Ferguson, during his twenty years at Nilambur, was for two months in April and May 1872, necessitated by constant attacks of fever. One of these two months was subsequently considered as duty and from this date the officer in charge of the Nilambur plantations was, in the interest of his health, permitted by Government to spend one month every year on duty at Ootacamund. When he retired on the 28th July 1883, Mr. Ferguson's health was completely broken down and he was not sorry to leave. He had, however, the satisfaction of knowing that he had effected a considerable extension of the plantations with almost complete success and had greatly developed the general activity in the Division.

147. *Acquisition of further forests.*—In 1868 negotiations were set on foot for the acquisition of the Chatomborai block from the Wandur Nambudri. These were completed in 1871 and the block was planted up, commencing from the following year. As a result of the lease of Chatomborai on rather favourable terms to the owner, the Amarampalam Raja, in 1871, offered Government the Old Amarampalam forests, containing a teak plantation, planted partly in 1862 and partly in 1869, together with the Karumpoya forest. The main reason for this offer was the Raja's need of ready cash to liquidate his debts. Government at first demurred at this further acquisition, but, on receipt of a report, dated 6th May 1872, from Mr. MacGregor, then Collector of Malabar, they sanctioned the payment of Rs. 80,000 for these lands—Rs. 10,000 for the teak plantation and Rs. 70,000 for the rest. Mr. MacGregor gave a short resume of everything which had been done in the forests already acquired; he then pointed out that the further extension of planting in Nellicutta, commenced in 1870, was impossible owing to the extremely feverish nature

of the locality and that the balance area in healthy localities, suitable for planting, was extremely limited. He drew attention to the extreme value of the plantations, as illustrated by estimates which had recently been made. Major Beddome, the Conservator, made no comment on this report because, as he stated in a subsequent letter, dated 12th June 1872, he wished to inspect the forests again before giving an opinion. He fell ill, however, and before going on leave, in the above letter, advised strongly against the acquisition without a more detailed enquiry into the charges on and receipts from the plantations. His reasons may be quoted :—" I have not of late taken such a sanguine view of the value of the Conolly teak plantations, as most persons visiting them have done; considerable portions will be failures and, at my last visit, I saw signs of premature decay in some of the older trees which I had hoped were not more than two-thirds towards maturity. I trust that this latter was owing to exceptional causes and that it may be confined to a few trees, but it made me anxious and I looked forward with great interest to my proposed visit this year; in any case, I feel pretty sure that the yield per acre, taking it all round, will be much less than it has generally been estimated at, and when we come to calculate the cost for the very long period that is required for the maturity of the timber and the compound interest upon the charges and superintendence over a period of fifty-sixty or even eighty years, as the case may be, I am afraid that there will be little left as profit." The acquisition of the land, however, had been completed before this letter was written, but this extract has been quoted, as it led indirectly to the compilation of Mr. MacGregor's and Colonel Beddome's reports of 1873 and 1877, respectively, which are of great interest and some statistical value. These reports will be dealt with partly in the second section of this chapter

148. *Extension of the plantations.*—The extension of plantations during this period was not continuous. With the increased establishment sanctioned in 1867, Mr. Ferguson was able to raise the average area planted during the next nine years to about 125 acres per year, with the result that the total acreage planted to the end of 1876 amounted to over 3,100 acres. In 1876 Colonel Beddome visited the plantations and, in his report to Government, advised that further extension should be stopped for the time being. The two reasons he gave for having come to this decision were—firstly, that a very large area had been planted, the work of tending alone being very heavy, and, secondly, that he would rather see the money expended on the improvement of the mountain teak forests. In the latter connexion, he was very doubtful of the ultimate value of the Nilambur teak as compared with the mountain teak. At the same time he reported that he saw no further signs of premature decay, which he had noticed and drawn attention to in 1872. Mr. Logan, the Collector, was diffident in expressing an opinion on this question, but he pointed out that some of the biggest logs could be tested; that the plantation teak must be of great value as there would be so many to the acre in a most accessible locality and that the Karumpoya block had been purchased for the express purpose of planting. Nevertheless the Board of Revenue and Government agreed with the Conservator, with the result that no planting was carried out from 1877 to 1885, both years inclusive.

149. *The introduction of exotics results from the stopping of planting.*—With no further planting to supervise, Mr. Ferguson, in 1878, started to experiment, on a considerable scale, with exotics, particularly Swietenia Mahoganii, the Mahogany, Hevea Braziliensis, the Para rubber tree, and with Burmese bamboos. These exotics are to be found now, scattered all over the plantations, formed prior to 1877. Their occurrence is recorded in the detailed description of compartments. The largest areas were planted up with mahogany and rubber in 1879, 1880 and 1881 in Kamalur and Aravallikava in blanks caused by storms in 1862 and 1879. The bamboos were planted along the river banks after the indigenous bamboo had partly flowered in 1881. From this time up to the date of his retirement, Mr. Ferguson's reports are mainly devoted to the exotic experiments.

150. *Fellings and other works undertaken.*—With Mr. Ferguson's advent, a considerable extension of departmental fellings was made. In addition to the departmental extraction and sale in situ of teak, rosewood, Terminalia tomentosa, Lagerstroemia microcarpa and Xylia xylocarpa from the outturn of clear-fellings for new

planting, Mr. Ferguson carried out selection fellings of the above species from Pannengode, Pokode, Walluvasseri, Ezhuvambadam and Nellicutta. The fellings in the plantations were confined to thinnings and the extraction of wind-blown and broken trees. The felling and collection at riverside was carried out departmentally, while the rafting and floating to the Kallai depot was executed on contract. The other works executed during this period, subsequent to the planting and preliminary weeding, were the regular clearing of all the undergrowth in the plantations; the pruning of forked stems; the clearing of parasites which consisted in cutting off the branches infected by a species of Loranthus first noticed by Dr. Cleghorn in 1867; the fire tracing of the plantations, which, however, was not attended with very great success, though the fires were mostly attributed to incendiarism, and, finally, the first survey of the forests, which was commenced in 1868. During 1870 and 1871 there are several records relating to this survey. Mr. Ferguson identified and cleared all the boundaries for this purpose. There were many disputes as to the boundary, particularly in the outlying portions, which were settled on the spot prior to the survey. The description of the boundaries of the forests, given in the lease deeds, by which Mr. Ferguson showed that he was guided, are in places very vague, and there is little doubt that some portions, to which Government were entitled, were never surveyed.

C.—Period 1883—1895.

151. *General.*—This third period in the history of these forests nearly coincides with Mr. Gordon Hadfield's charge of the Division. Since the first detailed working plan for these forests came into force from 1895, it seems advisable to commence the next period from that date. The general history of this period is derived partly from administration reports and partly from reports of Mr. Hadfield, Major, later Colonel, Campbell Walker, Mr. Cherry, Mr. Peet and Mr. Gass, Conservators or acting Conservators. This period is notable for the introduction of two thinning schemes for 1885–89 and 1890–94, drawn up by Colonel Campbell Walker. These schemes will be dealt with in the second section of this chapter. With the passing of the Forest Act in 1881, an office was organized, standard registers were introduced and the procedure was regulated by the general rules. It is, in fact, from this date that more or less complete records are available. The Division was divided into three Ranges—Nilambur, Amarampalam and Palghat, the last of which, on the formation at a later date of the Central Coimbatore Division, was reduced to the Mannarghat Range. The forests of the Palghat or Mannarghat Range are not covered by this working plan, so that these subsequent alterations are of no present importance. With the Division into Ranges, the subordinate establishment was remodelled on the standardized lines. The points of general interest will be dealt with in the following paragraphs.

152. *Acquisition of further forests.*—In December 1887 the New Amarampalam forests were purchased in public auction and taken possession of in March 1888. This purchase completed the acquisition of all the forests covered by this working plan. In 1892 the jenm title of the Old Amarampalam and Karumpoya blocks was purchased so that these two blocks passed into the absolute possession of the State. During this period the Chatomborai, Nellicutta, Old Amarampalam and Karumpoya blocks were notified as reserved forests under section 25 of the Forest Act, as has been recorded in Chapter I.

153. *Extension of the plantations.*—As a result of Major Campbell Walker's visit to the plantations in 1885, he suggested, to meet an increasing demand for small poles, the extension of the plantations. In consultation with Messrs. Logan and Hadfield, he drew up a scheme, with estimate for planting up 1,000 acres in ten years, the teak to be planted 6′ × 6′ with mahogany standards 50′ apart. The teak was to be worked as coppice on a short rotation. This scheme was sanctioned after some delay and planting was recommenced in 1886. Moreover, in the nine years remaining of this period, Mr. Hadfield cleared and planted 1,100 odd acres. With regard to the teak, this was by no means a complete success, for several areas selected were entirely unsuited to this species, while the mahogany in good teak areas was completely suppressed.

154. *Fellings and other works undertaken.*—In 1885 Major Campbell Walker proposed the extension of fellings in the natural forests, which had been commenced by Mr. Ferguson. He proposed that they should primarily be for the improvement of the growing stock—teak, rosewood, Pterocarpus Marsupium, Lagerstrœmia microcarpa and Terminalia tomentosa to be favoured. Such fellings were carried out partly by departmental agency and partly by purchasers of the trees standing. These fellings were not heavy, while the newly-purchased New Amarampalam forests were not worked at all. Indeed Mr. Peet, in an inspection note of 1889, noted that Mr. Hadfield had marked out the boundaries of these forests and considered that they should simply be protected until they had recovered from the effects of overworking previous to purchase. In preparing the sites for new planting, Mr. Hadfield instituted the system of selling the standing stock to a contractor whenever he could obtain a purchaser. This system has been followed up to recent times in spite of the fact that, according to data obtained, at least 90 per cent of the profit passed into the hands of the contractor. The fellings in the plantations were confined to thinnings, which, from 1885 to 1894, both inclusive, were regulated by the schemes prepared by Colonel Campbell Walker. The timber operations were effected with the help of hired elephants, while Mr. Hadfield instituted capturing operations by pits, which were so successful that he soon had a number of Government elephants for this work. Other works undertaken during this period, besides planting, weeding, pruning, etc., were fire protection, which seems to have been very successful and the clearing, in 1884, of 6′ lines round the boundaries of each year's plantation, in order to facilitate inspection and to serve as interior firelines. In 1886–87 the site of the District Forest Officer's present bungalow was acquired and the building, the road thereto and a well were completed in 1890–91. The thanks of all subsequent District Forest Officers are due to Mr. Hadfield for the selection of this most excellent site. Inspection bungalows or serambis were built at Mundakadavu, Pannengode and Old Amarampalam: also an office, now the Range office at Nilambur. Two wells were dug in the office compound.

155. *Proposals for the preparation of a regular working plan.*—When Colonel Campbell Walker drew up the second thinning scheme for 1890–94, he proposed the appointment, at the close of this period, of a special officer to prepare a regular working plan dealing not only with thinnings but with final fellings, regeneration, etc. In 1893 Mr. Gass endorsed Colonel Campbell Walker's proposal to appoint a special officer to prepare a connected history and plan for the plantations. In accordance with these proposals, Mr. P. M. Lushington, Deputy Conservator of Forests, was appointed in October 1894 to carry out this work. His working plan is divided into (1) History with appendices, (2) Working scheme for the plantations with appendices and (3) Working scheme for all the natural forests covered by the present plan, except the New Amarampalam reserve. The first two parts were completed in March and the last in April 1895. The working plan laid down prescriptions for ten years and was revised by Mr. Lushington himself in 1904–05.

D—Period of Mr. Lushington's first working plan, 1896–1905.

156. *General.*—The principal prescriptions of Mr. Lushington's first working plan may be enumerated :—

(*a*) To treat all the plantations as a high forest, to be clear-felled and artificially regenerated. Rotation 95 years for I class and 140 for II class soils.

(*b*) To increase the severity of the thinnings; good localities to be more heavily thinned than poor localities; all plantations in one block to be thinned in the same year; thinnings to be repeated every five years.

(*c*) To extend the plantations by about 80 acres a year.

(*d*) To clear—fell the irregular plantations of Ramalur and Aravallicava, which contained mahogany and rubber and to replant them with teak.

(*e*) To cease the experiments with exotics.

(*f*) To put a stop to the regular clearing of the undergrowth, except prior to a thinning.

(*g*) To carry out selection fellings in the natural forests.

The principal works carried out during the preparation of this plan were an enumeration of the number of trees in each plantation; the remeasurement of ten and measurement of fourteen new sample plots; the preparation of a stock map of the plantations, dividing the teak growth into three quality classes by eye and indicating the distribution of exotics, swamp and areas that had failed; and a short description of each compartment. All the prescriptions of the plan were accepted and sanctioned by Government in 1896.

157. *Modifications of the plan proposed by Mr. Ribbentrop, Inspector-General of Forests.*—In March 1898, Mr. Ribbentrop, the Inspector-General of Forests, visited the plantations and prepared a note on the working plan. He recommended the preparation of a detailed soil map of all the plantations and of areas selected for extension, with a view to ascertaining the limits to which successful planting could be carried on laterite and swampy soils, which limits should strictly be followed in further planting. He advised the annual extension of planting over as large an area of suitable soil as the labour supply would permit; the discontinuance of the regular clearance of undergrowth with a view to the protection of the soil and the natural pruning of the epicormic branches; the replacing of inferior teak and the replanting of areas, on which teak had failed, with mahogany and other soil improving species; the retention of the irregular mahogany areas in Aravallicava and the felling of the teak standing over the mahogany; and the continuance of experiments in planting mahogany and rubber-yielding plants, of which he specially recommended Ficus elastica. Mr. Ribbentrop's suggestions were accepted almost in their entirety and, after some delay, were embodied in a supplemental working plan, drawn up by Mr. Grenfell in 1902.

158. *The execution of Mr. Lushington's and Mr. Grenfell's supplemental plan.*—Perphaps the most striking feature of this period is that, while between 1844 and 1896 there were only three officers in charge, between 1896 and 1904 there were no less than twenty changes of officers. To quote Mr. Lushington in his revised working plan:—"For several months a Ranger has been in charge, and for no less than twelve months, on three occasions, the District Forest Officer, North Malabar, has done the work at Nilambur in addition to his own. It is not therefore surprising that the past management has not been as good as it should be and the prescriptions of the plan overlooked." No attempt was made to give effect to Mr. Ribbentrop's suggestions until 1902, while Mr. Lushington's prescriptions, in connexion with the manner of executing the thinnings, were practically ignored. The sequence of thinning the plantations, with one exception, was strictly adhered to. The extension of teak planting was carried out with fair success at the rate of slightly over 90 acres per year, with the result that, at the end of 1904, over 5,000 acres had been planted up altogether. Some of the fellings, proposed by Mr. Lushington, in the natural forests were carrid out, the majority of the trees being sold standing. The fire protection during the period proved completely successful. Of the roads, buildings, etc., constructed, the following may be mentioned. The road from Nilambur through Mundakadavu to Kanhirakadavu was constructed between 1896 and 1900. The first section of this road, as far as Karulai, was undertaken by the Local Fund Department. Within the same period, the Pannengode road, the Ranger's, Deputy Rangers' and Foresters' quarters at Nilambur and the serambi at Edacode were constructed. In 1902-03, the present District Forest office and the serambi at Nedangayam were built. While between 1904 and 1906, the old Range quarters, office, store-room, kitchen to the serambi, the foresters' and guards' quarters and the elephant kraal at Nedungayam and the guards' quarters at Nellicutta were built.

E—Period of Mr. Lushington's second working plan from 1906—1915.

159. *General.*—In 1904, Mr. Lushington was posted to the division, as District Forest Officer, with orders to revise his working plan in addition to his other duties. This plan refers only to the planted area and the sites selected for further planting. The prescriptions are approximately the same as in the previous plan but are more clearly indicated. Mr. Lushington found that the rotation for I class soils had preveously been under-estimated and that for II class soils over-estimated. Such results are due to his assumption, on both occasions, that the annual increment of the future

would be constantly equal to the periodical mean annual increment for the period immediately preceding the last measurement. Fortunately this mistake led to no serious consequences, such as premature fellings. Even if such fellings had been prescribed, the mistake should have been detected in time, for the trees would not have attained the required size. As regards thinnings, Mr. Lushington emphasized that the espacement of the trees of the final crop was the most essential point to look to and, that this should be more strictly attended to than in the past decade, he prescribed that, in all plantations over 50 years of age, the 60 trees per acre likely to provide the 40 trees of the final crop should be permanently marked and not removed in thinnings until the number of trees per acre had been reduced to 60. For the formation of new plantations, he selected and marked out sites, averaging 130 acres each, and prescribed that the planting distance should be increased to 8′ × 8′. He included Mr. Grenfell's proposals to plant up the blanks in the plantations with mahogany and prescribed that all seedlings, poles, etc., of valuable species should be encouraged in such areas. In marshy blanks he proposed the planting of Ficus elastica. With regard to the clearing of the undergrowth in the old plantations, he left it to the discretion of the District Forest Officer to clear undergrowth prior to a thinning, as seemed most advisable. Finally, to safeguard against the unsatisfactory marking for thinning, noted in the past decade, he laid down that not less than 25 per cent of the area should annually be marked by the District Forest Officer himself and that the balance should be checked. Mr. Brasier, the Conservator, disagreed with several of the above prescriptions, or considered them inadequate. These disputed questions were then referred by Government to the Inspector-General of Forests.

160. *Modifications of the plan suggested by Mr. Eardley Wilmot, Inspector-General of Forests.*—Mr. Eardley Wilmot considered that Mr. Lushington's prescriptions regarding thinnings were sufficient; that the extension of plantations should be limited only by considerations of labour and the funds available; that the planting distance should not be constant for all site qualities, a closer spacing being necessary on poor soils, and suggested that the Burma system of planting closer in the lines with the lines wider apart might be tried; that the extension of mahogany and rubber plantations should be stopped; that the weeding and clearing of undergrowth should be subject to the control of the Conservator; that pruning of forked stems, etc., was necessary only at an early age, while, in conclusion, he laid stress on his suggestion that all markings for thinnings should be carried out by a gazetted Forest Officer under the direct supervision of the District Forest Officer. These suggestions were approved by Government and the working plan modified where necessary.

161. *The execution of this plan.*—After Mr. Lushington's departure in 1907, it was not till 1910 that an Imperial officer, Mr. Wimbush, came to the division to stay for any length of time. In the meantime the division was frequently held in double charge for short periods by the District Forest Officers of North Malabar and the Nilgiris. The thinnings and the tending of the young plantations suffered greatly under these conditions, indeed many of the failures in the plantations of 1907–1909 are attributable to neglect of weeding. No attention was paid to the prescription of varying the espacement of planting according to the quality of locality and a constant espacement of 8′ × 8′ was followed. Considerable failures occurred in these new plantations, partly accountable for by neglect, as stated above, but more often due to selection of unsuitable sites, particularly badly drained alluvial soil. Mr. Lushington, as Conservator of Forests, inspected the plantations in 1911 and, in his inspection note, expressed his great disappointment in the recent plantations. He found it very difficult to state the cause for this comparative failure, but thought that it was due, in great measure, to the fact that the difficulty of procuring labour had caused the early weeding to be less carefully attended to. He considered that, with the altering conditions, under which so many of the species were becoming saleable, the management should terminate their efforts in the direction of artificial regeneration and make "a real endeavour to obtain natural regeneration not of one but of several of the best species." He ordered that the site for the 1912 plantation should be reduced by one half. In the following year, Mr. Lodge, the Conservator of Forests, endorsed Mr. Lushington's decision and even went further in advising the

complete cessation of planting for the present. He, further, on Mr. Wimbush's recommendation, advised the cancellation of the prescription of selecting and marking the final crop trees in plantations over 50 years of age and a revision of the method of measuring sample plots, adopted up to that time. Mr. Wimbush carried out much heavier thinnings in the plantations, which had such good results that they enabled the writer, who took over charge of the division early in 1913, to execute still heavier thinnings in the next felling cycle. Beyond the thinnings, no other fellings were carried out, except that dead and windblown trees in parts of the natural forests were sold to contractors. Of the roads, buildings, etc., constructed during this period, the following may be mentioned. Serambis were built at Kanakuth and Arambrakutta in 1907-08, at Karien in 1911-12, at Narakadavu and Korampoya in 1912-13, at Pulimunda in 1913-14 and rebuilt at Nellicutta in 1914-15. Wells were dug at Nudungayam in 1909-10 and at Karien in 1911-12. The bridges on the Karulai road were reconstructed in 1914-15 and the Chanakundu Mukku-Kanhirakadavu road was metalled in 1913-15. Late in 1914, the attention of the Conservator was drawn to the fact that the prescriptions of this working plan would come to an end in 1915 and that arrangements must be made for its revision. The writer was entrusted with the preparation of this new plan in addition to his other duties and the work was commenced after the monsoon in October 1915. "

F.—The period of the preparation of Mr. Bourne's working plan, 1915-1918.

162. "*General.*—During this period, particular attention was paid to thinnings, the same felling cycle, introduced by Mr. Lushington, being continued. In 1916, after it had been proved to the satisfaction of the Conservator, that areas could be selected for the extension of planting, which would give complete success, planting was restarted on a small scale and extended in the following years. In 1917, on the inquiry by the Conservators' conference whether teak fellings could be extended, it was suggested that the final fellings, to be prescribed by this working plan, could be commenced. One of the oldest plantations was clear felled and replanted during this year and such fellings were continued in the following years. The large quantity of teak supplied in these two years resulted in a great expansion of the ship building on the coast. Finally, in 1918, the fellings in the natural forests, to be prescribed by this working plan, were started. Of the roads, buildings, etc., constructed during this period, the following may be mentioned. Forest guards' quarters were built at Padukai in 1915-16, at Edacode in 1916-17, and at Arimbrakutta in 1917-18. A Tannah office was also built at Mundayanthodu Mukku in 1916-17. Wells at Nellicutta and Arimbrakutta were dug in 1915-17. The Mundayanthodu Mukku road was constructed in 1916-17; the Mundakadavu-Padukai-Chalikal bridle-path and the Pulimunda road were completed in 1917-18 and the Nellicutta-Palat road was constructed in 1918-19. Owing to the new felling operations, the annual works of extraction, etc., were more than trebled. The greatest credit is due to the subordinate staff of all ranks, with few exceptions. Without the capable assistance of Mr. Swami Kutty, the Nilambur Range officer, whose organization of the labour supply was admirable, these results could not have been achieved. In December 1918, the writer handed over charge of the Division to Mr. G. C. Robinson, under orders to complete the writing up of this working plan in addition to his new duties."

G.—Period of Mr. Bourne's working plan, 1918-1928.

163. *General.*—The past decade, though it commenced in an era of unprecedented prosperity, has proved to be the darkest period in the whole history of the forests. Mr. Bourne commenced his working plan late in 1915 and had collected all his facts by the end of 1918. At that time there was a tremendous boom in the timber market and prices were still rising. All species were saleable at a profit—often a very handsome profit—and the immediate adoption of the policy of clear-felling the natural forests and raising regular plantations of miscellaneous species by artificial regeneration, on a large scale, seemed desirable. Recent teak planting operations (both on natural forest clearings and on sites of old plantations) had been uniformly successful and no fears were entertained for the continued prosperity of the plantations. The prevailing optimism was short-lived. Mr. Bourne left the

Division in December 1918, and continued the preparation of his working plan, in addition to his new duties in the Forest College at Dehra Dun. Owing to lack of help with the masses of figures which he was compiling in connexion with the working plan and the yield tables, he was unable to submit the plan for sanction until early in 1922. In the meantime the Malabar rebellion had broken out. Most of the forest buildings were destroyed and the whole organization of the division was plunged in chaos. Further, the scarcity of bamboos subsequent to flowering was much more serious than he can have anticipated, so that, even if his expanded programme of fellings could have been carried out, and the material extracted to the river bank, floating would have been impossible. Also, the timber market was exceptionally dull. His ambitious working plan could not have been submitted under less favourable auspices. In the circumstances, the most that the Chief Conservator could recommend was that Mr. Bourne's proposals for working the existing teak plantations should be followed, and that his other proposals should be re-examined when order was restored in the division, and when the Chief Forest Engineer (whose appointment was then under consideration) would be available to give advice in the question of mechanical haulage. The Government expressed their concurrence in this view, in G.O. Mis. No. 931, Development, dated 12th July 1922. Thus the working plan has never been sanctioned. Its prescriptions have been followed, more or less, as regards the Plantation Working Circle. The replanting of teak in the second rotation has given the most disappointing results, so far. Conversion of the natural forests has proceeded on a modest scale. Except in small experimental areas, conversion has been confined to teak planting, and the results are indifferent in many cases owing to various causes, both administrative and natural. The re-examination of Mr. Bourne's proposals was commenced in November 1925, when the present writer was posted as a Working Plan Officer in the newly-formed Working Plans Circle with orders to revise the plan. The Chief Forest Engineer's staff is now engaged in mapping and enumerating the natural forests of the inaccessible working circle, with a view to determining the possibility of large scale development. Proposals for using a tractor for extracting timber (chiefly from the final fellings in the plantations) have been formulated. The management of the forests during the past decade is described in detail in a later section, so it is unnecessary to do more, in the following paragraphs, than to describe outstanding circumstances which have affected the administration of the period.

164. *The Malabar Rebellion of* 1921–22.—A history of the rebellion, except in so far as it affected the Nilambur division, is out of place in this working plan. The Administration Report of 1921–22 contains a very poor account of what occurred, so the writer may be pardoned for the following somewhat lengthy narrative. Many of the facts have been obtained from Khan Sahib K. Kunhirayan who, as Range Officer, Amarampalam range, rendered most valuable service to Government. In the Nilambur locality the outbreak occurred on 21st August 1921. On 22nd August the District Forest Officer (Mr. M. C. Chandy) and the Rangers of the Nilambur range, together with their families, moved to Nedungayam, as being somewhat removed from the centre of activities, and where they could rely on assistance from Ranger Kunhirayan, himself a Mappilla, and a man of influence in the neighbourhood. About the 24th August a party of some 300 armed rebels went to Nedungayam and burnt all the forest buildings, despite the Range Officer's efforts to dissuade them. They turned the Government elephants loose in the forest, but the Range Officer was able to send four elephants (on loan, at that time, from the Nilgiris division) up to the Nilgiris, surreptitiously, through the forest, by a way known to their mahouts. The main object of the rebels at Nedungayam was to convert the District Forest Officer and Rangers, and their families, to the Muslim faith, and they would have proceeded to do so, by force, but for the Range Officer's stratagems. He arranged that they should be lodged in a good house near Karulai, and suggested that their conversion could be more satisfactorily accomplished by peaceful means. Having thus provided for their temporary safety, he himself, on the pretext of seeking his mother's approval to his joining the rebels, went to Mambad, where he enlisted the support of a Mappilla friend named Koyamamu Musaliar (who subsequently was made a Khan Sahib for his good services to Government). Together they mustered and

armed about 150 loyal Mappillas, and set out by night, in small parties, to Karulai to defend the District Forest Officer and other forest officers, and to get such information as they could about the plans of the rebels. They found that the latter had revived their intention of forcible and immediate conversion. Thereupon Ranger Kunhirayan by various ingenious ruses, managed to get the District Forest Officer and his party firstly to Nilambur, thence to Koyamamu's house in Mambad, and finally to Calicut, in boats, by night. When the rebels discovered that they had been tricked, they burnt the District Forest Officer's bungalow, the circuit house, and all the buildings in the office compound at Nilambur. As soon as they had got the District Forest Officer and party to Calicut in safety, Ranger Kunhirayan and Koyamamu returned to Mambad, and were able to minimize the theft of timber from the Government rafts along the river and from river-side depots. While at Mambad, the Ranger got in touch with the Government elephant men, provided them with food, and made them go out and find the elephants and prevent them from straying to remote parts of the jungle. In this way all the elephants, with the exception of one new capture, were eventually recovered. One of the elephants, Dostijehan, died shortly after being brought back to camp, as the result of 19 gun-shot wounds received from the rebels. He had been 'musth' and is said to have killed six of the Mappillas who tried to take him away for their own work. One forest guard, one reserve watcher and one tappal peon were killed by the rebels. Seventy-two Government buffaloes were slaughtered for food, and only ten were eventually recovered. At the end of December 1921, Ranger Kunhirayan returned from Mambad to Nilambur, and on his own initiative collected coolies and burnt the fire lines in the plantations of the Nilambur range. In February 1922, having completed the fire protection at Nilambur, he went to Nedungayam and continued the work there. No damage to the forests by fire is recorded, so it is unlikely that any serious injury was sustained. All the plantations formed in the monsoon of 1921 had to be replanted in 1922, as they had failed, for lack of weeding. Replanting has met with little success. No fellings nor thinnings were carried out during 1921–22.

The following list shows the value of the live and dead stock, stores, etc., lost in the rebellion and written off:—

	RS.	A.	P.
Cash	519	14	3
Seventy-two buffaloes and one elephant	17,200	0	0
Miscellaneous stock, such as timber, bamboos, stationery, uniforms, etc	24,950	0	0
Stores (excluding buildings)	9,000	0	0
Buildings destroyed and damaged	41,240	0	0
Total ...	92,909	14	3

By February 1922, the rebellion was practically suppressed, and the subordinates returned to work. In recognition of his excellent service to Government during the rebellion, Ranger K. Kunhirayan has been the recipient of the title of Khan Sahib.

165. *Changes of officers.*— The frequent changes of officers during the last period have had a most marked deleterious effect on the administration of the division. Generally speaking, the selection of planting sites has been very faulty. Regeneration operations have often been carried out very badly, owing to inexperience of local conditions, and the same must also be said of the thinnings in some of the plantations. Labour has been allowed to get out of hand, and it is believed that the work of some of the subordinates has not been as satisfactory as would have been the case with continuous supervision. Rates for all works have mounted up, in some cases to an alarming extent. The frequency with which officers have been changed is seen from the following list, with dates, of the officers who have held charge of the division :—

Mr. R. Bourne from 1st April 1918 to 21st December 1918.
„ G. C. Robinson from 22nd December 1918 to 15th January 1921.
„ F. D. Ardagh from 16th January 1921 to 4th March 1921.
„ M. C. Chandy from 5th March 1921 to 17th August 1922.

Abdul Quadir Sahib from 18th August 1922 to 25th May 1923.
Mr. G. C. Robinson from 26th May 1923 to 12th August 1924.
,, Govinda Menon from 13th August 1924 to 26th August 1924.
,, P. W. Davis from 27th August 1924 to 14th October 1924.
,, D. F. Stileman from 15th October 1924 to 5th December 1924.
,, A. F. Minchin from 6th December 1924 to 30th April 1925.
,, A. C. Littlewood from 1st May 1925 to 1st April 1926.
,, C. M. Kushalappa from 2nd April 1926 to 11th May 1926.
,, A. C. Littlewood from 12th May 1926 to 17th June 1926.
,, E. M. Crothers from 18th June 1926 to 12th April 1927.
,, C. M Belliappa from 13th April 1927 to 3rd June 1927.
,, E. M. Crothers from 4th June 1927 to date.

Changes of the officers in charge of the Nilambur range have also been the rule, though not to the same extent as in the division.

166. *The floods of* 1924.—A general account of the damage done by the 1924 floods has been given in the section on injuries to which the crop is liable, and the compartment histories contain notes on the injury to the compartments affected.

167. *Teak regeneration with field crops.*—In 1926 and 1927 practically all the teak planting on clear-felled sites of the old plantation was done in conjunction with field crops. This innovation was ordered by the Chief Conservator following a tour of inspection in Travancore where this method of regeneration is attended with excellent results. It is regrettable that the method was not tried first on an experimental scale. Conditions in the Nilambur plantations are quite dissimilar to those obtaining in the localities in Travancore where the method is so successfully practised. As a result of this departure from the usual practice, practically the whole of the 1926 regeneration area in the Plantation Working Circle has been an utter failure, and the 1927 area is a partial failure and will require extensive replanting in 1928. The 'ponam' method was also tried in small areas, both in 1926 and 1927, on natural forest clearings. On such areas results are better but except in small patches none of the results can be considered good.

Section 2—Past Systems of Management and their Results—1843–1918.

168. *General.*—In the previous section since it seemed the most suitable and clearest method, the general outline of the history has been dealt with by periods. In this section, however, it is proposed to discuss the past treatment of the plantations and natural forests separately and by subject heads, formation, tending, protection, etc. This method permits of easy reference being made to the past treatment on any particular subject. The reader, having obtained a general idea of the history and the conditions prevailing from period to period, will, it is hoped, be in a position to appreciate the details of the past treatment, the reasons for its adoption, the correctness or otherwise thereof and its results. Since the dangers to which the natural forests and plantations are exposed and the precautionary or remedial measures adopted are frequently common to both, the protection of the forests will be dealt with under one heading.

A.—Plantations.

169. *Methods of formation adopted.*—Unless otherwise specified, the plantations refer to teak only. It took Mr. Conolly exactly two seasons to realize that success in raising teak could not be attained by scattered sowings and transplanting of natural seedlings in the forest or even in open patches. He, then, immediately started to try and raise seedlings from seed in a nursery. As has been recorded in the previous section, some seedlings were successfully raised in 1843. The history of the evolution of the method followed at the present time will be traced in the following paragraph :—

(*a*) *Teak nurseries.*—The first success was obtained by soaking the seed in cold water for twenty-four hours, piling them in small heaps covering with straw and watering them daily until germination commenced. This procedure was shortly modified, in that the seeds were removed from the heaps after three days and sown, an inch spart, in nursery beds, ready prepared. The sowing was completed by the 15th April, that is about six weeks before the normal burst of the south-west monsoon. In preparing the nursery beds, a light fresh soil was selected, close to the river; the surface

was covered with a thick layer of fallen leaves, litter and wood ashes and the whole well dug into the ground. Beds were formed about 3 feet broad and 15 to 20 feet long. After sowing the seeds, they were covered with a layer of fallen leaves and straw, which were kept in place by sprinkling a little earth on top. The beds were then watered once a day, morning or evening, the seeds germinating after ten to fourteen days. This method was followed by Mr. Chatu Menon up to 1862, after which Mr. Ferguson introduced certain modifications. With slight alterations, his method is followed to-day and it is worth quoting the description of the method, which he wrote out in 1863 :—

"(1) Collect seed from trees with a clear stem, free from decay and of vigorous growth ; February the best month to collect in."

"(2) *Preparation of nursery beds.*—Select good free soil, dig 12 inches deep (now dug to 3 feet), removing weeds, roots and stones ; when caked, the soil should be reduced to a fine mould and the nursery levelled ; line of beds 3½ feet wide and 1 foot space betwixt each bed and its fellow, then raise an outer edging round each bed 3 to 4 inches high ; beds, when thus finished, will be about 2½ feet wide between the edgings and 120 seers of seed will suffice for 150 feet in length of the above-sized beds ; sow from 2nd to 15th April before sowing, steep the seed 48 hours in water, then sow and cover with a thin covering of fine soil nearly 3¼ inches (now about the thickness of the seeds), then cover with straw to retain the moisture ; betwixt the soil and straw a very few small twigs without leaves to prevent the straw from being washed into the soil by water ; which, if allowed, is apt to destroy the young seedlings on its (straw) removal. Water daily copiously, say, a common earthenpot of water to each two running feet of length of bed less or more according to free soil or otherwise ; in this way the seed will germinate in from 10 to 15 or 20 days or more according to freeness of soil ; water less as the plant strengthens but keeping up sufficient moisture till the monsoon sets in from the first to the third week in June, when the plants will be from 4 to 8 inches high and ready for planting out permanently." Mr. Hadfield used to soak the seeds rather longer. This is, however, not necessary. He also sowed the seed later, about the 25th of April, in order to obtain smaller plants. This has been found to be unsafe, since the monsoon has been known to set in as early as 12th May. If the monsoon is late, the biggest plants can be set aside, only the smaller plants being utilized.

(*b*) *Selection of site for planting.*—The great importance of this question and the frequent faulty selection of site in the past has been referred to . . . In 1843, Mr. Conolly was warned by Dr. Roxburgh of Calcutta, to avoid low-lying, inundated land for planting. This advice was strictly followed until 1855, at least there are no failures in the plantations up to this age, due to the swampy nature of the ground. On the other hand, there are considerable failures in plantations from 1850, due to extensive planting on laterite soils, parts of which were entirely unsuitable. In 1863, Mr. Ferguson recorded that marshy and laterite (rock) soils were quite unsuitable for planting. He again emphasized the latter point in 1874. This was probably due to the fact that considerable areas in 1868 and 1873 were failures for this reason. Nevertheless he continued to include such areas in the further sites selected by him. Mr. Hadfield included a certain amount of swamp and laterite outcrop in the plantations formed by him. In 1896, Mr. Lushington drew attention to the failures on these classes of soils When proposing the extension of plantations in the Karumpoya block, he stated that there were not less than 2,500 acres (allowing over 1,000 acres for marsh, hills and places far from rivers, etc.), chiefly of first-class soil. Unfortunately he did not distinguish between the open swampy forest and the fully stocked swampy forest,—stocked with such species as Terminalia tomentosa, Lagerstroemia Flos-Reginae and bamboo. When clear-felled and planted with teak, the teak failed and the area became an open grass swamp. From 1897, several such areas were included in the new sites. In 1905, when selecting further sites for planting and marking them on the map, he again excluded only the open swamps. To prove this fact is easy, for there are many examples in the Karumpoya plantations, where they border on forest as yet unplanted, though selected in the past for planting, in which the swampy nature of the locality is evident. As recorded in the last section, extension of planting was put a stop to in 1912, on account of the failures, which were attributed mainly

to want of weeding. Experience has shown that no amount of weeding will make teak thrive, while it will never survive, as a complete plantation on such areas. It must therefore be recognized that alluvial soil, whatever its depth, is unsuitable to teak unless properly drained. As regards the failures on laterite soils, the insufficient depth of the soil is the primary cause. Where the hard laterite rock is close to the surface, the soil becomes so shallow and so coarse that it cannot retain sufficient moisture for the growth of the teak plant after a few years.

(c) *Preparation of site for planting.*—After failing to obtain success with natural transplants in the forest, Mr. Conolly, in 1843, started to cut down and burn all growth other than teak. In these clearings seedlings were transplanted, but, with complete success, apparently only in the open. For, from the ensuing year, the forest on the sites selected was clear-felled, except for promising young teak poles, and the debris burnt. Writing in 1846, Mr. Conolly commented on the much better results obtained on land which had been clear-felled and burnt in contrast to some open grass lands or glades, which he had planted up with the idea of saving the expense of clearing the jungle. Recent experience has shown that the fiercer the fire, the better the resultant growth, at least in the first year. This may be due to several causes, separate or combined :—the quantity of mineral ash returned to the soil ; the complete oxidation, particularly of acids in the soil ; the thorough aeration of the upper layers ; and the complete destruction of roots and seeds of weeds. The difference in the amount of weeds, that spring up during the first year, in areas where the intensity of the fire was great or little is amazing. The amount of debris available for burning is thus of great importance. In new clearings of natural forest there is never any scarcity. In clearings of old plantation, however, when all the timber and some of the branchwood in the form of spokes and felloes is removed and when there is little undergrowth, it is difficult to obtain a sufficiently fierce fire. Under such circumstances, the branchwood of the teak should on no account be disposed of as fuel or by a process of destructive distillation. In the same way, if an area is cleared and burnt but not planted immediately and after a year or two is reburnt and planted the resultant growth is very poor. This would appear to be due to an injurious effect of the weed growth on the soil and an insufficient amount of material on reburning to counteract it. Probably incomplete combustion or oxidation of acids. In connexion with the old record that teak poles were not felled on sites for planting, confirmation of this is available at a later date. In December 1859, one Corporal Hall was sent by Dr. Cleghorn to fell some of the ' ripe teak, ' which, he stated, had been left standing when the plantations were formed. Corporal Hall reported that he had felled 40 such trees, each almost 15 cubic feet in contents. The record of work done shows that these trees were felled, partly from Aravallicava 1844, 15 years old and partly from Mulathamanna 1848, 11 years old. If the cubical contents, as reported, is correct, such trees must have been promising poles when the plantations were formed. Again, Mr. Ballard, the Collector, writing in 1862, stated : " There is a good deal of large teak, scattered about up and down the plantations. It proves to have been a mistake leaving it, as all the young teak near are stunted." It may, therefore, be assumed that, from this time or even before, the areas were absolutely cleared. The damage to the surrounding seedlings by ' drip ' caused by leaving trees on an area, is, here, well emphasized. There are, however, some examples in later plantations of rosewood trees, which are obviously older than the teak. This is explained by Mr. Ferguson, who, writing in 1874, noted that a large number of rosewood seedlings had been conserved, subsequent to his taking over charge in 1862, on sites for new planting. In some cases they must have been good sized poles. but, no doubt, he considered it an advantage to obtain a few rosewood at the expense of some teak.

(d) *Espacement of planting*—On Doctor Roxburgh's advice a regular close espacement, 6—10 feet apart, was adopted from the start. From a memorandum prepared by Mr. Chatu Menon in October 1857, it appears that the actual espacement was in the Quincunx form, the sides of the square being 7 feet. This means that the plants were about 5 feet apart. Mr. Ferguson, in his prescriptions for planting, noted that a distance of 6—8 feet apart proved the best. Colonel Beddome, in his report of 1877, was more exact and stated that the planting at that time was in square spacing $6\frac{1}{2}' \times 6\frac{1}{2}'$. It is probable that this espacement was followed throughout Mr. Ferguson's

time. From the recommencement of planting in 1886, according to Colonel Campbell Walker's scheme, the espacement was 6′ × 6′. This was regularly adopted up to 1904. In 1904, Mr. Brasier discussed the advisability of wider planting. He prepared estimates to show that the adoption of square spacing, 9′ × 9′ instead of 6′ × 6′ would reduce the cost of formation of one acre by Rs. 10. His estimate of planting 9′ × 9′ is unsound, because he reduced the cost of weeding in proportion to the reduced number of plants, whereas he should, if anything, have raised it. In addition to the reduction in cost, he referred to the fact that thinnings would be postponed and, in consequence, unsaleable saplings of small dimensions would not be so numerous. He claimed further advantages for wider planting: (1) that less labour would be required ; (2) better development of crown. Finally he advocated that part of the area planted should be 6′ × 6′ and the other 9′ × 9′ according to the quality of the soil. The 1904 plantation was planted on this principle. Mr. Lushington, in dealing with this question in his revised working plan, wrote : "Considering that all our planting is now done on first-class soils there can be no possible danger in wider planting and, in addition, I claim for it that the plants will become better able to withstand wind in later years. There is, however, the objection of two parts of a plantation requiring different treatment if the planting is done partly 6′ × 6′ and partly 9′ × 9′. If the planting is done uniformly 8′ × 8′, we shall reduce the number of plants from 1,210 to 680." He, therefore, prescribed a constant spacing of 8′ × 8′ and, in spite of Mr. Eardley Wilmot's suggestion, accepted by Government and incorporated in the plan, that the spacing should vary with the quality of the soil, his original prescription was followed. Now it seems highly probable that this wider spacing, particularly on good soils, has resulted in the natural forking, in the third to the fifth year, of an undue proportion of the trees. Commencing with the portion of the 1904 plantation, planted 9′ × 9,′ and throughout the subsequent plantations, planted 8′ × 8′, a very high proportion of the stems, particularly of fast grown dominant trees, are forked naturally at from 10 to 40 feet from the ground. A simple theory may be put forward to account for this phenomenon and peculiar coincidence. The height growth of teak, during the first two or three years of life, is so great that all the energies of growth are concentrated on the leading shoot, so that few and frequently none of the lateral auxiliary buds develop into branches. From the end of the third to the fifth year, the tree commences to form a crown. The closer, within limits, the spacing, the longer this crown development is deferred—the tree is not encouraged to develop its lateral branches and the conducting tissues, which feed the lateral buds, lying, as they do outside the main tissues which feed the leading shoot, are not stimulated. The tree simply continues to develop its leading shoot at the normal rate—the height growth is maintained and the diameter growth is not encouraged. If the planting distance is so increased that the plants do not close up by the end of the third year, the end of the period of maximum height growth, lateral branches are then vigorously developed, resulting in such stimulation of their conducting tissues, that the time soon arrives when the terminal auxiliary buds develop as soon as or before the bud of the leading shoot. Natural forking results. There seems to be little doubt that the increase in the planting distance, from 6 to 8 feet, had this result. This forking, at such heights as 10 to 40 feet, is difficult to remedy by pruning. Indeed no such pruning was done. When, therefore, the writer, after thinning plantations, planted 6′ × 6′, came to thin, for the first time, the plantations, planted 9′ × 9′ and 8′ × 8′, he was confronted with an extremely difficult operation. Time and time again a forked dominant tree had suppressed the four trees nearest to it and had therefore to be left. They were too old and the limbs too big to permit of satisfactory pruning. The value of these trees, many of which will have to remain till the final crop, will be greatly reduced. Under these circumstances, when the planting was recommenced in 1916, the espacement was again reduced to 6½′ × 6½′ and 6′ × 6′. The adoption of an espacement 6½′ × 6½′ on good soils was decided upon for the simple reason that the exact espacement of the trees left standing after any thinning must depend upon the original spacing. It was found by experience that, after the first and second thinnings, which take place during the period of most rapid growth, the best average spacing would result from an original planting espacement of 6½′ × 6½′. Mr. Eardley Wilmot's suggestion, that the method of planting closer in the lines with the lines

wider apart might be tried, was not followed, so that it is impossible to say whether such espacement would result in undue natural forking. The close spacing, $6\frac{1}{2}' \times 6\frac{1}{2}'$ and $6' \times 6'$, adopted in the past, resulted in such straight, undivided stems, that it should be departed from in the future only for silvicultural and not economical reasons. Such economy may well prove to be false economy in the end.

(*e*) *Planting out.*—From the commencement, holes, 12 inches square, were dug, into which the plants were put. The ground round the hole used also to be hoed up. The digging of the pits one foot square has been and is followed to the present day. The position of the pits is accurately marked out according to the espacement adopted. The earth is removed and heaped by the side of the pit. As soon as the pits have been inspected to ensure that they are of sufficient depth, the earth is replaced. The actual method of planting has not varied much Mr. Chatu Menon used to take up the plants from the nursery, with a portion of the mould attached to the roots so as to protect the tap-root, and plant them direct into the pits immediately after the first heavy rains of the monsoon. For the first week or 10 days he used to water the plants on any day on which there was no rain. For the first two or three weeks each plant was protected by a small enclosure, two feet in diameter, made by striking leafy branches into the ground and bent over the plant. On the advice of Dr. Roxburgh, he used to plant only small seedlings, as the risk of damage to the tap-root was then minimised. Mr. Ferguson used to cut and shorten the tap-root to six inches when lifting the plant from the nursery bed. He drew attention to the fact that, after about three months, the seedling's tap-root rapidly swells like a carrot and that such seedlings are not suitable for planting. He, therefore, laid stress on the advisability of using small seedlings and, for this reason, deferred the sowings from the 15th to the 25th of April. He discontinued the watering and the erection of protective enclosures for each plant Mr. Hadfield disagreed with the cutting of the tap-root, and was not in favour of taking up the plant with a ball of earth as this added very considerably to the cost. He selected only small vigorous seedlings, which were just beginning to send out a new pair of leaves, and snipped off all the leaves except the terminal pair, because the heavy rain spattered mud on to the leaves and frequently bent the plant over to one side. In dry weather especially he dipped the roots in liquid manure before planting. He also considered it necessary to put the plant in well above the collar, in fact to cover the two lower leaves, as the heavy rain in this locality was so apt to carry away the loose soil and wash the plant out if it was not deeply embedded. This method has been followed to the present day, except that the plants are not dipped in liquid manure and planting is never done in dry weather. Recent experience has shown that 100 per cent success can only be expected when the planting out is executed during actual rain or on cloudy days and such weather continues, with daily rain, for at least two or three days after completion of the work. If there is much sun on the day or for a day or two after planting, 50 per cent or more of the plants wilt and die, having to be replaced when the rain recommences. Not only is much replanting necessary, but the difference in the resultant growth during the first year is enormous. The abnormal monsoons of 1917 and 1918, particularly the latter year, in which the first burst of about a fortnight's almost continuous rain was followed by a long break and spell of cloudless days, exemplified the results of such conditions. At the end of the year, the amazing difference between that part of the plantation, which was completed a day or two before the end of the first burst of rain, that part completed only on the last day or two of rain, and that part, the planting of which had to be deferred until the rain recommenced, had to be seen to be appreciated. The early monsoon of 1918, bursting, as it did, on the 12th of May taught one further lesson. The fellings must be completed in time for the outturn to be removed ; the area to be burnt, and the unburnt debris to be cut up, piled and reburnt before the end of March. The area can then be pitted in April as soon as the ground is softened by the first showers and will be completely ready for planting, however early the monsoon bursts in May. Owing to scarcity of funds in 1917–18, the clearing of the area had to be deferred until after the 31st of March with the result that it could not be burnt completely and was not absolutely ready for planting on the 12th of May.

(*f*) *Weeding in the year of formation.*—The old records show that Mr. Chatu Menon used to clear the weeds for two feet around each plant, hoeing up the ground

in addition. In 1857, he recorded that these weedings were carried out as often as necessary. Beyond this, there are no details, but the complete stocking of the resultant plantations, on good soils, shows that the weeding was never neglected. Mr. Ferguson carried out four and Mr. Hadfield three weedings in the first year. Mr. Lushington left the number of weedings to the discretion of the District Forest Officer ; three weedings were generally made. Recent experience is such that, if the first weeding is carried out before the weeds fruit in late July or early August, and, if strips, four feet wide, two feet on each side of the rows of plants, are absolutely clean-weeded, a second weeding in September-October is generally sufficient on good soils. Three, however, are necessary wherever the teak growth is backward. The ground should then be clean-weeded for two feet all round the small plants. It is most important that this should be done in December, while there is still plenty of moisture in the soil. If not carried out till January, the weeds have so lowered the actual water content of the upper layers of soil, that the sudden exposure of the teak plants causes them to wilt and die. As noted in the previous section, the fiercer the preliminary fire, the fewer the weeds that spring up. Patches have been seen on which only a few scattered weeds had to be pulled up at either weeding. That neglect of weeding in the first year will result in practical failure of the plantation is illustrated by the Karumpoya plantations of 1907, 1908 and 1909. The best example is that of 1907, where it adjoins the plantation of 1901. On the 1901 side of the fire line is a fully stocked area, mostly average quality ; on the other, the 1907 side, an irregular stocked area, with small patches of average quality teak scattered in an otherwise blank area, except that the blanks are stocked with weeds, grass, lantana and natural regeneration of Lagerstroemia microcarpa, Terminalia paniculata and Macaranga Roxburghii. On such an area the height growth during the first year would have been from 2–6 feet, unless the plants had been smothered by weeds. In the second year they would have put on about seven feet in height, being free from the danger of weeds early in the year. The monsoon of 1907 was also an extremely favourable one, as is evidenced by an examination of the rainfall records. Under these circumstances, there is no doubt that the failures in this area are due to neglect of weeding in the first year. Indeed, the importance of the weeding in the year of formation cannot be over-emphasized. In 1868, with the idea of reducing the amount of weeding necessary during the first year, Mr. Ferguson experimented by sowing paddy between the planted teak, over an area of one acre. Five paras of seed were sown and, in October, 38 paras were reaped. In reporting on this experiment, Mr. Ferguson stated that the growth of the teak in this area had been very much retarded in comparison with the surrounding area, which was treated in the ordinary way. In other areas, during this year, native vegetables were grown between the teak, with the same evil results. Judging by this experiment and the effect of only cutting the weeds instead of clean-weeding, the presence of any growth, in proximity to the teak plants, retards their development. During the months of heavy rainfall such growth retards surface evaporation and drainage. With such heavy precipitation as occurs, even the most porous soils become water-logged unless freely drained on the surface. Such water-logging results in the exclusion of oxygen from the soil, consequent bad aeration and retarded growth. Even on the best drained soils the growth of the shoot of teak is very slow during the rains. Soon after the rain ceases it develops rapidly. This is undoubtedly due to good aeration. On badly drained soils or if dense weed growth is permitted the soil remains badly aerated even after the monsoon. Under such conditions the rapid development of the shoot does not follow. This, it is believed, is the explanation for the necessity of clean-weeding during and immediately subsequent to the monsoon.

170. *Preliminary tending for the proper establishment of the crop.*—The preliminary tending, necessary for the proper establishment of the young crop, varies to some extent according as to whether the plantation is on a new site or on the site of clear-felling old teak plantation. The difference will be explained in the last of the following paragraphs: —

(*a*) *Weeding from the second year onwards.*—Whereas Mr. Chatu Menon weeded whenever necessary, Mr. Ferguson prescribed four weedings in the second year, three weedings for the next three years and two for the sixth year. Mr. Hadfield

reduced the weedings in the second year to three and in subsequent years to two. Mr. Lushington, in 1895, left the number of weedings to the discretion of the District Forest Officer, but in 1905, at Mr. Eardley Wilmot's suggestion, the Conservator prescribed that, as a general rule, the following number of weedings would be required :—

Plantation in its year.	Number of weedings. First-class soils.	Number of weedings. Second-class soils.
Second	3	3
Third	2	3
Fourth	2	3
Fifth	1	2
Sixth	...	2
Seventh	1	1
Eighth	...	1
Ninth	..	1

Many of these weedings were actually found unnecessary. At the present time, if the weedings of the first year are properly executed, one weeding on first class and two or possibly three on other soils are required in the second year, while in the third year weedings are only required on poor soils. There is little doubt that many of the weedings, which used to be carried out from the second year onwards, were totally unnecessary and used to waste the time of labour, much needed on other works. It seems probable that many of such weedings were merely carried out for the appearance of the plantations, for both Mr. Ferguson and Mr. Hadfield had a horror of undergrowth.

(*b*) *Pruning*.—The first record of pruning operations dates from Mr. Ferguson's time. Prior to that, deformed stems are recorded as being removed in thinnings. Though Mr. Ferguson carried out pruning in plantations up to 20 or 30 years of age, Mr. Hadfield, afer two years, confined this operation to the young plantations. Mr. Lushington considered that it was only necessary during the first three years and in both of his working plans prescribed the pruning of forked stems and the cutting of strong lateral shoots that might appear within this period. In 1904, Mr. Brasier proposed pruning in older plantations, but this was not approved of by Mr. Eardley Wilmot. These operations have been carried out. In addition, owing to the undue forking in plantations, planted 8′×8′, a certain amount of pruning was attempted after the first thinnings. In recent plantations, it has been found that easily the best time to carry out the pruning necessary is at the beginning of the second year. The small seedlings often get damaged during the first year, both by cattle, deer and monkeys which destroy the succulent leading shoot resulting in unnatural forking. Experiment has shown that, if the branch or fork is cut off at the beginning of the second year, before the heart wood is formed, it is not only very easy to do, but the wound also heals very quickly, the shoot straightens and, at the end of the year, it is often very difficult to tell that any pruning has been done. By leaving the pruning to the end of the second year, the side branches and particularly the forks have become stout and woody ; a very sharp knife and considerable skill is required to remove them ; they take many times as long to cut, the pruning being therefore, very much more expensive and, what is most important, the stem is badly misshapen and will not always heal.

(*c*) *Preliminary thinning*.—This operation is confined to plantations on sites of old clear-felled teak. Since these fellings were commenced in 1917 only, the history is very recent. When clear-felling was ordered, it was realized that a considerable amount of natural regeneration would be obtained but that an irregular distribution might be anticipated. The area was, therefore, planted up in the ordinary way in June. A weeding became necessary in July and, since natural seedlings had just appeared, this weeding was carried out in such a way that the majority of such seedlings were preserved. The cost, however, was very high. It was found that, whereas the natural seedlings were very dense in patches, the seed having been washed down and deposited, there was hardly a seedling to be found over considerable areas. If natural regeneration had been relied on, such blanks would have had to be planted up very late in the season. In subsequent weedings also, the natural seedlings were preserved, with the result that, at the end of the year, patches

of an almost impenetrable thicket had been formed. Experimentally it was found, the majority of the planted seedlings having survived, that these thickets could easily be thinned out to the original planting distance, by checking the transplants in the rows and cutting back all the others. At this period, few of the planted seedlings had been suppressed, so that the resultant crop was regular and even-spaced, conditions which are essential for such a fast-grown species. If any of the planted stems were forked, they were pruned, while if they were suppressed or deformed, the nearest natural seedling was retained. This treatment was carried out throughout the plantation, with the exception of a small experimental plot, which was left alone. At the end of the second year, the plants in this area, 10—20 feet high, were already divided into the three classes, dominant, dominated and suppressed. It was found impossible to carry out a mathematical thinning, for the planted stems were frequently suppressed. Indeed, it was a most difficult operation and often impossible to obtain a regular even-spaced crop. After this experience, no attempt was made, in 1918, to rely on natural regeneration or to preserve natural seedlings during the first weeding. In this way, any thinning necessary could be reduced to a minimum, while the operation could be combined with the pruning at the commencement of the second year.

171. *Cost of formation and preliminary tending.*—For purposes of comparison at different periods in this locality and with other divisions, it is simplest to note the number of coolie units rather than the cost in rupees. Though the total cost per acre in the year of formation is greater to-day than in Mr. Hadfield's and Mr. Ferguson's times, when memoranda of planting expenses were prepared, the increase is solely due to the rise in coolie wages. On the other hand, the cost of preliminary tending is reduced. The following statement gives approximately the number of coolie units for each item of work per acre:—

Item of work.	Approximate number of coolie units per acre.
(*a*) Year of formation—	
Firing the debris after removal of saleable outturn	1
Cross-cutting remains of the first burn	14
Collecting and piling in heaps and burning clean	40
Lining, marking, pitting and planting out	14
Weedings and replacing of casualties	25–27
Collection of seed, preparing, sowing and watering the nursery beds	9
(*b*) Preliminary tending—	
By Mr. Ferguson. Weeding and pruning	110
By Mr. Hadfield. Do.	74
At the present time. Do., inclusive of preliminary thinning where necessary. Good soils ...	15
Average soils.	27
Poor soils ...	53

The total cost of formation, allowing for small contingencies, used to come to:—

In Mr. Ferguson's time ...	Rs. 54½; Rs. 27 in the first year and Rs. 27½ thereafter.
In Mr. Hadfield's time ...	Rs. 51; Rs. 30 in the first year and Rs. 21 thereafter.
At the present time on the average.	Rs. 52; Rs. 40 in the first year and Rs. 12 thereafter.

It must be noted that the above figures are for average monsoons, that they may be reduced with favourable rainfall and must be increased in bad years.

172. *Subsequent tending.*—Since the pruning of the older plantations in the past has already been recorded, the tending operations, now to be considered, are the clearing of undergrowth and of parasites, and thinnings.

(*a*) *Clearing of the undergrowth.*—Subsequent to the weedings, Mr. Chatu Menon preserved the undergrowth, but from 1862 Mr. Ferguson commenced to clear it annually. It seems that his reason for commencing this was due simply to his training in Scotch plantations, in which undergrowth was discouraged. No serious fires occurred until 1866, so that it is doubtful whether he was influenced by the fear of fire. Mr. Hadfield continued these clearings, though only every other year.

As has already been noted, Mr. Lushington, in 1895, discouraged such regular clearing, except just prior to thinning, leaving the decision to the discretion of the District Forest Officer. Writing in 1904, he stated that the clearing had been stopped to a certain extent, but that too much licence had been given to the Range Officer. At the same time, considering that Messrs. Ribbentrop and Brasier would prohibit the clearance of all undergrowth, he was of an opinion that such total prohibition would be dangerous, particularly in respect of fire. His prescription, therefore, may be quoted:—"I wish it to be clearly understood that I am not advocating a general clearance of the undergrowth, which has already done much to enrich the soil and improve the plantations, but I do think that there is considerable danger in the undergrowth and that the best time for its removal is at the end of every five years immediately preceding the thinnings. I shall, therefore, prescribe as follows: 'Before commencing marking for thinning, the District Forest Officer should personally inspect the area to be thinned, and decide which compartments, or part of the compartment, require weeding. This inspection should, as a rule, be carried out during the first break in the south-west monsoon, so that the operation of thinning and dragging can be carried out without difficulty.'" Mr. Eardley Wilmot considered that Mr. Ribbentrop's views had been misinterpreted. The conclusion of his opinion may be quoted: "Undergrowth is necessary to the welfare of the teak and should not be interfered with unless it is injuring the principal species. Its removal in order to make the forest accessible is a question entirely apart on which the local officers must decide the necessity." Accordingly Mr. Lodge, the Conservator, prescribed that the undergrowth should not be interfered with except for the maintenance of fire lines, etc.; to permit of access to sample areas; the removal of weeds, noxious growth and climbers prior to a thinning and at other times only with the previous sanction of the Conservator. From that date, no clearing has been done, except the cutting of climbers and the clearing of parallel lines, prior to thinning, in order to facilitate marking. Nevertheless, when felling and dragging takes place, considerable damage is done to the undergrowth, preventing it from becoming too dense. The result of the regular clearing from 1862 to 1896 and the partial clearing up to 1906 is a scarcity of undergrowth in many of the older plantations. This has, unquestionably, acted deleteriously on the soil. During the growing season the teak canopy gives good shelter to the ground, while in the monsoon the intensity of the sun's rays is not great. With the fall of the leaves, however, the sun beats intensely on the fallen leaves and the soil, causing rapid disintegration and decomposition of the soil and any organic matter present. In fact, there is no accumulation of humus and the surface soil is easily washed away in the ensuing monsoon. Wherever an evergreen undergrowth is present, grass and herbs have disappeared and an accumulation of organic matter and the formation of humus is to be seen.

(*b*) *Clearing of parasites.*—The cutting off of branches, infected by a species of Loranthus, was commenced from 1867, when this pest was first noticed. The operation was carried out irregularly at first, but in more recent times has been prescribed for the year in which the thinning is executed. Coolies were sent up the trees to cut off the infected branches, which were then collected, piled and burnt. In 1905, Mr. Lushington prescribed that these branches should be stacked and measured, prior to burning, a practice which had been followed for the previous few years. This was later discontinued, for the best check on the execution of the work is to inspect the plantation when the trees are leafless and the presence of any further parasities can immediately be detected.

(*c*) *Thinning.*—In 1851, Mr. Conolly obtained permission for Mr. McIvor, the Superintendent of the Horticultural Gardens at Ootacamund, to visit the plantations and advise upon the necessity of thinning, which he considered to be necessary. Mr. Chatu Menon was unfortunately absent during Mr. McIvor's visit and the latter, failing to see all the plantations, only advised pruning. On a further request from Mr. Conolly, he again visited the plantations in 1852 and marked for felling the crooked and diseased stems in the plantations of 1843 and 1844. Later in 1854, in a letter, dated the 30th June, he advised the thinning of further plantations and the removal of 'one tree from between every two.' In a subsequent letter, dated the 4th November, with reference to thinning, he stated that the work "requires much judgment, as well as a perfect knowledge of the matter, so

as to be able to retain only such trees as are free from disease and of a robust health, clearing away such as are stunted and deformed, and this selection must not interfere with the trees being left at regular intervals." He was then asked to carry out these thinnings himself during the ensuing dry weather. Meanwhile, Doctor Gibson, the Conservator of Forests in Bombay, and his assistant in Kanara, inspected the plantations in November 1854 and advised the thinning out of one-fifth of the smaller trees and a further one-fifth after seven years. Early in 1855, Mr. McIvor carried out the thinnings in the plantations of 1845 and 1846. From present knowledge of the approximate number of plants, which survive per acre at ten years of age and from the records of saplings felled. Mr. McIvor must have removed between one-third and one-half of the number of stems standing. In 1857, Doctor Cleghorn, in a letter to the Collector, wrote: "There seems to be only one essential to the entire success of this great experiment, viz., the careful, systematic thinning and pruning of the plantation. The good effects of Mr. McIvor's visits to Nilambur are manifest." In October 1857, Doctor Cleghorn again visited the plantations and left Corporal Hall to carry out some thinnings. From October 1857, statements of work done each month are available, and from these statements it appears that Mr. Chatu Menon commenced himself to thin out saplings which stood too close together. Early in 1858, Mr. McIvor again visited the plantations and thinned several of them. From this date thinnings were carried out fairly regularly. Yet the reports of inspecting officers, Mr. MacGregor in 1859 and 1860, Mr. Grant and Captain Morgan in 1861 and Captain Beddome in 1862, all drew attention to the need of still further thinning. This does not necessarily mean that the thinnings were very light, but that there were still more plantations needing thinning or re-thinning. In 1861, Captain Morgan advised against the too heavy thinning out of the older plantations, all at once, and suggested that thinnings should be repeated every three years. On taking over charge of the plantations in 1862, Mr. Ferguson, emphasized the necessity for further thinning, and started at once to put his suggestion into practice. In 1867, Doctor Cleghorn reported favourably on the progress in thinning and pruning. In a memorandum on planting expenses, appended to Mr. MacGregor's report of 1874, Mr. Ferguson remarks: "If the plantations are intended for first-class timber, the thinnings should begin from the sixth or seventh year." From Colonel Beddome's report of 1878, it appears that Mr. Ferguson actually began the thinnings in the ninth year, with further thinnings to follow in the 13th, 16th, 20th, 25th and 32nd years. It may be remarked that he seems to have inclined to leave the trees in groups rather than evenly spaced. This fact has been referred to here, as it has been the cause of several subsequent criticisms. Fortunately, in his enthusiasm over exotics, Mr. Ferguson never neglected his thinnings, which were executed regularly and continued by Mr. Hadfield. In 1885, Colonel Campbell Walker wrote as regards thinnings: "Altogether the impression left upon my mind, after a careful examination, is that the condition of the older plantations is critical; that they must be very carefully watched and thinned with great judgment during the next five or ten years; and that we must endeavour to get the trees in the younger plantations, retained for final crop, into a better and more natural condition and habit of growth before they arrive at their thirtieth or, at latest, their fortieth year." Again he wrote: "We do not really care to have the trees, except a few for special purposes, over two or two and a half feet in diameter, which dimensions are not uncommon already at five feet from the ground in the oldest and best compartments. What we hope is that the trees will increase in girth higher up the stem from the fortieth to the sixtieth year, and present fine, straight, clean boles, with massive crowns, instead of tapering whiplike stems, with few branches and little foliage at the top, but numerous branchlets down the stem. The former condition can only be attained by giving each tree sufficient light and room, and encouraging it to cover its own ground by judicious and early thinnings." At the same time he thought it would be very dangerous to thin out heavily, all at once, the older woods. With these considerations in mind, he drew up a preliminary scheme for thinning, from the year 1885–1889, forming the blocks into six circles and allotting a portion of each circle to each year. He also drew up two statements—(1) showing the average number of stems per acre, remaining in each compartment; this was compiled from past records, which were inaccurate at the very start, and not from enumeration; and (2) showing the number of stems which he thought, in consultation with Messrs. Porter and Hadfield, should remain at each age, if

the objects in view were to be attained. That this scheme was based on inadequate data is shown from the fact that he had fixed 800 stems to be left at the first thinning in the eleventh year while, at the present time, on the best soils, with the same planting espacement, not more than 800 stems ever remain by the eleventh year. In fact, the great fault of this scheme, as of his revised scheme, was that no consideration was paid to the different requirements of different qualities. Good areas, which particularly needed heavier thinnings, continued to suffer from under-thinning. Subsequent enumerations showed that an attempt was made to leave the number of stems per acre laid down. The value of this scheme, however, lies in the regulation of the working, with the result that the years in which plantations were thinned have, from this date, been easily traceable. The Conservator, Mr. Cherry, in reporting on the plantations, after his inspection late in 1887, remarked that Mr. Hadfield found, on counting the trees, that the number per acre were much less than the number entered in Colonel Campbell Walker's scheme, and even less than the number prescribed to be left, and yet that the need of further thinning was apparent. Apart from this, he pointed out that there was a great demand for the smallest poles and, therefore, that earlier and heavier thinnings, even a removal of 50 per cent in the first ten years, were advisable both from silvicultural and financial standpoints. In November 1890, Colonel Campbell Walker, in reviewing the scheme for 1885–1889, considered that the thinnings, during this period, had effected a great improvement in the growth and healthy appearance of the trees. However, he recorded the fact that the number of stems, prescribed to be left at each age, was too high, except in case of very poor growth. Yet, in drawing up a scheme for 1890–1894, he prescribed no thinnings in many plantations, which, by enumeration in 1890, contained approximately the same number of stems, as were prescribed by the first scheme. He, thus, still adhered to his former prescriptions, which he admitted effected an underthinning. He seems to have been influenced by the fact that the demand for saplings of all sizes had been very poor during recent years and that there was a large balance unsold at the depot. Judging by the number of stems removed, deducted from the actual number previously enumerated, the majority of plantations, at the end of this period, contained fewer trees than the number prescribed. In his working plan of 1896, Mr. Lushington dealt with these thinning schemes in great detail and summarized what he considered to be the chief defects. Since his prescriptions sought to overcome them, this summary may be quoted:— "(1) That the proper enumeration of trees had not been made; (2) that the thinnings were too much scattered; (3) that the differences in soil were not taken into account; (4) that the yearly thinnings were insufficient and if the thinnings were increased at this stage, too much light would have been let in and (5) that the executive officer was too much tied down by the plan and could not thin sufficiently in some places where thinning was required." As regards the first point he made enumerations in a ten-year plantation, otherwise depending upon past experience and enumerations. As to the second point, he refixed the felling cycle at five years and confined the thinnings of one year, as far as possible, to whole blocks. The average area to be thinned each year was rather over 900 acres. As to the third and fifth points, he divided his prescription into two parts—one dealing with the new plantations, the other with the old. For the new plantations, he prescribed the first thinnings at ten years and fixed the number of stems to be removed at each thinning, on a different scale for first and second-class soils. On first-class soils the thinnings were virtually to be completed by the 35th year, with 60 stems per acre left standing. For the older plantations he prepared a similar scheme for thinnings from 20 to 50 years of age, but on a much lighter scale for each soil quality. For thinnings in the oldest plantations, he laid down a special prescription which, with his concluding remarks on the whole subject, may be quoted: "In dealing with thinnings in plantations where the trees are of very large size, it is necessary to mark the trees to be thinned two years at least before the actual thinning takes place and in these two years to arrange for the gradual removal of the top branches. This will enable the canopy to close before the actual thinning takes place and thus avoid large gaps in the canopy which would admit wind and endanger the growth of these plantations. It must be recollected that the cutting of thinnings is a silvicultural operation with a view to the improvement of the final crop. These prescriptions, based on previous experience, are intended as a guide to the executive officer who must use his discretion in performing the operation and not consider himself tied

down by the figures given." Thus he made no suggesstion as to how the operation should be carried out in each quality and at different ages and made no mention of the types of trees to be removed. In preparing his revised plan in 1905, he realized that his prescriptions had been too indefinite. At the same time it was very unfortunate that there had been so many changes of officers. He considered that the thinnings had been very badly carried out and remarked that several officers had confined the marking, both on alluvial and laterite soils, to the removal of dominated stems. He wrote: "This is opposed to all principles of silviculture, for, whilst on poor soils it is only dominated trees that can be removed, on alluvials it is essential that dominating trees should be taken out, and a dominated tree can be left, provided that it will continue living to the next rotation (of thinnings) and does not interfere with the crowns of trees which are required to form the final crop. Instances of innumerable trees of large size are found, in which the espacement is ten feet or less, whereas according to the plan the espacement of the trees for the final crop should be from 28 to 33 feet. It is in this matter of espacement, or in other words the proper distribution of the trees of the final crop, on alluvial soils, that the great mistake has been made." And again "In order that this should be more strictly attended to than heretofore, the plan prescribes that, in all plantations over 50 years of age, the trees which are expected to form the final crop, should be marked and counted, prior to the compartment being marked for thinning. This must equally be attended to in the young plantations, though, in them, the trees are too numerous to mark. On all alluvial soils, the marking, as a rule, should be confined to dominant trees and dead trees. A dominated tree should not be removed unless interfering with the crown of a tree likely to form the final crop. On dry and laterite soils the marking will, as a rule, be confined to dead, dying and wind-topped trees, and, it is only where the trees are too crowded in groups that a dominant tree should be removed. It must be remembered that two good trees within a few feet of each other cannot be allowed to stand for the final crop, and it is, therefore, desirable that one of them should be removed at as early a stage as possible." Beyond this more definite prescription as to how the thinnings were to be carried out, the thinning scheme remained the same, except for the allotment of the new plantations to the different years of the felling cycle. Mr. Lushington considered that the statements of number of stems to be removed at each thinning, for different soils and for the old and new plantations, might still be taken as a guide. These prescriptions call for some criticism. By the allotment of the young Karumpoya plantations only to the second cycle of thinnings, the first marking in these plantations was deferred to the 11th—14th years. At this age the average height of dominant stems is over 60 feet on first-class soils. Innumerable examples were to be found of trees, of this height, in their original spacing, 6 feet apart,—two vigorous plants, neither of which would give in to the other. It may readily be understood that they had no crown on one side, for the branchlets of teak are extremely sensitive to friction under which influence they simply die back. One had to be removed and, the other having no crown on that side, an exceptional gap had to be created. Under such circumstances it was very difficult and frequently impossible to leave the trees in even spacing. Moreover, the loss of increment caused by such congestion must be considerable, few, even of the dominant trees, having good crowns. Further the thinnings, prescribed in the younger woods, are extremely light. The figures given by Mr. Lushington as a guide were based on an enumeration of a plantation, which present stock mapping shows to contain very little good growth. This probably explains the above fact. The figures, given by Mr. Lushington, are compared with the number of stems left per acre, under recent thinnings, in the following statement:—

Age at which thinning is carried out.	Number of stems left per acre				
	Under Mr. Lushington's scheme.		At the present time.		
	First-class soil.	Second-class soil.	First-class soil.	Second-class soil.	Third-class soil.
10	500	600	266	322	404
15	250	450	179	222	290
20	150	300	137	169	224

Mr. Lushington's first-class soils are approximately comparable with first and second-class soils to-day and his second with the present third. For the older plantations, his figures are a fairly good guide. In the execution of these thinnings no continuity of method was attempted until Mr. Wimbush's arrival. Commencing rather cautiously, there is no doubt that he tended to thin heavier each year, with the most beneficial results. In the five odd years the writer was in the Division, he carried on these thinnings to a still heavier degree, more particularly in the younger plantations. Such plantations, as stated above, were as such as 11 years old and had never been thinned. Either the old system of leaving dominant trees too close together had to be continued or the wood had to be heavily opened up. No intermediate course was possible. A small part of 1902 plantation was experimented with without any consequent damage from wind. The resultant crown development in one year was so great that several of the whippy stems were bent right over by the weight of the new foliage. Such stems were successfully tied up and after one year could support themselves. Other congested young crops were then heavily opened up on the same principle without resultant wind damage, except in the case of the very congested plantation of 1901. This damage was caused by a severe storm in May 1918 just after the plantation had been thinned. A fairly large number of poles were broken. The damage, however, is not irreparable and the canopy in the damaged portions will be closed again within 20 years. A warning must, therefore, be conveyed against the heavy opening up of very congested young crops in which there is no crown development. Almost all the young crops have now been heavily opened up once and proper crown development stimulated. All future young plantations will be thinned from an early age with this same object in view. Once this is accomplished there should be little fear of further serious breakage by wind. In the older plantations, which had not been due for thinning in Mr. Wimbush's time, many instances of two trees only 12 feet apart were found. In spite of Mr. Lushington's explicit instructions, marking officers had not had the courage to cause a temporarily large gap by the removal of one. It would appear that, counting on someone else carrying out the marking five years later, they considered that it could not do much harm to shelve the decision. One of such trees throughout has now been removed. The thinning had frequently to be very heavy, but the fears, expressed by several officers in the past, that such drastic opening out of the old plantations might be followed by extensive wind damage, have been set at rest. Many violent storms have since been experienced without damage in such woods, while the windbreak has been more or less confined to congested crops which were still in need of further thinning. The guiding principle of all thinnings, within the last five years, has been the even espacement of the trees, with a view to the development of good crowns. It should be remembered that the teak is completely deciduous during the dry weather, affording in any case no protection to the ground. It is such a fast-grown species and its crown is so quickly restricted by friction the moment it comes in contact with that of another tree, that the method of thinning should aim at an even espacement of dominant trees and the removal of any tree which interferes with the proper crown development of the former. This, to all intents and purposes, is Mr. Lushington's prescription for the treatment of the best growth. The writer can affirm that it has been carried out, though more drastically than Mr. Lushington contemplated. It has also been applied to both good and bad soils, for both of which it is the most suitable. As regards Mr. Lushington's prescription to mark the final crop trees in plantations over 50 years of age, this was carried out, frequently by Range Officers or other subordinates from 1896. Mr. Wimbush, in 1912, pointed out to the Conservator that the procedure took for granted that trees, once the best members of a crop, must always remain so and, further, that it presupposed that the officer, selecting the final crop trees, had more silvicultural knowledge than officers who might carry out thinnings subsequently. In consequence this prescription was cancelled. On the expiry of Mr. Lushington's prescriptions in 1915, the writer carried on, more or less on the same felling cycle as before, in order that he should be able to thin over all the plantations in the division, once during his period of office. At the same time he thinned two of the new plantations yearly, so that the age of first thinning was eventually reduced to eight years. While in 1914 and 1915, he succeeded in marking all the plantations personally, for the last three years, with the preparation of this working-plan in addition, he was forced to confine his personal marking to compartments of good

growth. In the older plantations, the principle stated above has been followed. Special mention, however, should be made of the thinning in the older plantations of the Walluvasseri block, which was well thinned by Mr. Wimbush, with some assistance from the writer, in 1912-13. A final thinning or perhaps it may be termed an increment felling was carried out in 1917–18, as the statistics collected indicated that the best results would thus be attained. In the younger plantations as soon as the age of the first thinning was reduced to ten years, a mechanical thinning was carried out as far as possible, every other tree in each row being removed. Owing to the undue proportion of forked stems and the irregular distribution of the dominant trees, this mechanical method had frequently to be modified. Nevertheless, wherever it could be carried out, it ensured an equal growing space for each tree and, what was very important, gave the marking officer a definite standard, by which he could be guided, thus giving good results without requiring great skill. The writer has experimented with this method of marking in younger and more regular plantations and has found that, if the first thinning has been carried out at the age, by which domination has not yet become serious, a mechanical marking, removing 50 per cent of the stems, will give such a regular espacement that it cannot but result in the maximum increment per stem and per acre. It has, similarly, been possible to determine the age at which a second thinning would give the same results. Considering the enormous growth in height, during this early period, and the rapid construction of crown which follows congestion, too much emphasis cannot be laid upon the importance of absolutely even espacement, if the same is to be achieved at later ages.

173. *Experimental formation of woods of indigenous species other than teak.*—The first attempt to plant indigenous species other than teak was made by Mr. Ferguson in 1868. He raised seedlings in the nursery and planted out, in the clearing of the year, rosewood, Xylia xylocarpa, Terminalia tomentosa, Hopea parviflora and a few less valuable species. In spite of watering, many of them died in the following March, a number of the first three species only having survived. No such attempt was repeated until 1902, when, under Mr. Grenfell's supplemental working plan, some planting was undertaken in the areas in which teak had wholly or partially failed. He prescribed that all natural seedlings should carefully be preserved and that rosewood, Pterocarpus marsupium, etc., and mahogany should be planted in gaps on dry soils and Terminalia tomentosa, mango, jack and Pongamia glabra on wet soils. These cultural operations were carried out up to 1912 but, as no weeding was proposed or carried out after the first year, very poor results have been achieved. Only in rare instances are the results of this planting definitely traceable to-day. Planting was often so scattered and then in such small patches that it is impossible to say whether the present growth of rosewood, Terminalia tomentosa or other such forest species is natural or artificial. The most definite results have been with rosewood in Walluvasseri 1888 plantation, where there is much rosewood in definite espacement, generally with dense Xylia xylocarpa natural regeneration, but, in one instance, practically pure. Planted in 1903, the average height in 1918, in this plot, was about 40 feet. In 1903 and 1904, also, a few small plots in the new clearings were planted with Pterocarpus marsupium and mahogany. Most of the former have been suppressed but, in 1918, the growth of the best stems was up to 33 inches in girth and 51 feet in height. In 1918, seedlings of several species were raised in nurseries with a view to the experimental establishment of small pure woods. The results showed that seedlings of Dalbergia latifolia, Terminalia tomentosa, Lagerstroemia microcarpa and Flos-Reginae, Xylia xylocarpa and Bombax malabaricum can be raised in large quantities without the slightest difficulty or uncertainty. This only confirmed previous work. With Terminalia paniculata, however, there was very poor result. It is believed that a very large percentage of its seed must be unfertile. Similar experiments will have to be continued with this species . . . Although large quantities of seedlings were obtained, the area in which they were to be planted out was unfortunately not completely burnt and ready for planting when the monsoon burst on the 12th May. The planting out, therefore, had to be postponed until after the first break in the rains. The majority of the seedlings were then some 6 inches high, while the Bombax seedlings were as much as $1\frac{1}{2}$ feet tall. Areas in

the 1918 extension unsuitable for teak were, however, planted up with these species partly in pure patches and partly mixed. Although many plants have survived, the resultant growth in the first year has been poor. So for the matter of that was the growth of the teak. This comparative failure is attributable to the area having been cleared in 1917, sown with teak and subsequently abandoned to weed growth owing to deficient germination and high cost of weeding. It was recleared in 1918 and then planted partly with teak and partly with these other species. This abandonment to weeds has obviously affected the soil. Add to this the late planting and there are ample reasons for not condemning these experiments at the outset. Indeed they have to be continued on lines laid down in this working plan.

174. *Experimental introduction of underwoods in the teak areas.*—In 1914, experiments were made with a view to introducing an indigenous species as an underwood. Rosewood, Lagerstroemia microcarpa, Hopea parviflora, Xylia xylocarpa, Cassia fistula, Artocarpus hirsuta and Dysoxylum malabaricum were tried. Seedlings of the first five species only were successfully raised and planted out, in fenced plots, in different localities and in plantations of various ages. The majority of plants died in the first year and, though casualties were replaced during the next two years, the results were so poor that the experiment was discontinued. A few rosewood and Xylia xylocarpa plants only are to be seen at the present day. It is probable that most of the failure is to be attributed to an insufficient amount of light. In 1916, seed of Hopea parviflora was sown in lines in the Forest Research Institute sample plot in plantation 1902, just after the thinning. A certain amount of seed germinated but no seedlings survived. A thorough examination was then made of all the natural regeneration forming an underwood in the plantations. There was no doubt that on alluvial soils by far the best result had been achieved, wherever the indigenous bamboo, Bambusa arundinacea, had formed a complete underwood. At the same time it was noticed that the bamboo regeneration would not remain as an underwood except on good soils. Advantage was taken of the flowering of bamboos, early in 1918, in Pokode and Kanakuth, to collect large quantities of seed. This was sown in small patches over some 2,000 acres on good soils in all but the oldest and youngest plantations. The result is not easily determinable. So much natural regeneration is to be seen in most localities, that it is difficult to trace the results of artificial sowing. Yet that some success has been achieved, may be deduced from a single example. In Pannengode 1887, Compartment 143, small clumps of bamboo are to be seen here and there in approximately even espacement. Since no bamboo in the vicinity has flowered, it is certain that these small clumps are the result of sowing.

175. *Experimental planting with exotics.*—The introduction of exotics dates from 1872, when two or three mahogany plants were obtained from the Government Gardens, Madras. One of these was put out in the Chatomborai plantation of 1873 and, by its vigorous growth, resulted in considerable planting of this species. It was not until Mr. Peet's inspection in 1889 that it was discovered that this plant was not the true mahogany, Swietenia mahagoni, but the variety macrophylla. Meanwhile six more plants were obtained in 1876 and both Colonel Beddome and Mr. Ferguson suggested that large quantities of seed should be obtained. All the seed sent proved to be of the true mahogany. Considerable planting of this species took place from 1878, particularly in the years 1879-1881, when gaps in some plantations, caused by storms, were planted up. Owing, however, to a borer, which attacks the terminal shoots, causing constant forking, all attempts at raising good trees were frustrated. When it was found that the one good tree was of the variety macrophylla, further seed of this only was obtained. With the renewal of teak planting in 1886, mahogany was planted about 50 feet apart. At first this was the true mahogany and it has almost completely failed. The variety macrophylla, though generally suppressed by the teak on good soils, is now dominant on others, particularly on laterite. The planting of mahogany 50 feet apart was stopped from 1896, when Mr. Lushington discouraged any further introduction of exotics. In deference to Mr. Ribbentrop's views, some mahogany of the macrophylla variety has been planted under Mr. Grenfell's plan as avenue trees, on laterite soils on which teak had failed and, in 1903 and 1904, in a few definite plots in the plantation of the year. It has been found that

the borer attacks the variety as much as the species, so that hardly a tree, with an undivided stem, is to be seen. For this reason alone, the planting of mahogany cannot be considered a success. In 1876 and subsequent years, plants of Ceara, Para and other rubbers were introduced. They were tapped from time to time, commencing from 1886. The work seems to have been so carelessly or badly done, that many were killed out. The Ceara rubber was found to reproduce itself very easily by seed and many plants are to be seen to-day, forming hedges around compounds in Nilambur. A few of the Para rubber trees still remain and, at the request of the rubber planters in the neighbourhood, were retained when the rest of the plantation was clear-felled in 1917–18. They have been and are suffering badly from 'pink disease,' Corticium sp., but do not appear to be affected by 'second leaf fall.' Other exotics introduced include a single mangosteen tree at Chaliar Mukku, which bears fruit annually, and a number of Burmese bamboos, by far the commonest of which is Cephalostachyum pergracile. These bamboos were introduced, when the indigenous bamboo partly flowered in 1881, particularly along the river banks.

B.—Natural forests.

176. *General.*—Operations in the natural forests, other than works of protection, have been confined to fellings of timber and bamboos.

177. *Timber fellings.*—While a few teak and rosewood were sold on kuttikanam (stump fee), prior to 1862, the first departmental extraction of timber was started by Mr. Ferguson, shortly after his arrival. He carried out selection fellings of teak, Terminalia tomentosa, Lagerstroemia microcarpa, Xylia xylocarpa, and a few rosewood, from the natural forests of Pannengode, Pokode, Walluvasseri, Ezhuvambadom and Nellicutta. A rough idea of the intensity of these fellings may be obtained from the following data; from 1873 to 1885, 3,431 miscellaneous logs, other than teak and rosewood, were obtained from Nellicutta, an area just over three square miles, of which present day stock-mapping shows one-third to be bamboo and swamp forest containing little or no timber. If the fellings were evenly distributed over the timber forest, this means that 2—3 logs were obtained per acre. Since many of the trees, which occur in such forests, would yield more than one log, these fellings should not have been excessive. Indeed the present growth in parts of Nellicutta is very fine and the pole growth, that must then have been freed, has benefited to a very great degree. At the same time these fellings do not appear to have increased the regeneration. From 1876, the departmental fellings were carried out more or less in rotation, in the above blocks, together with those of Nilambur, Kanakuth, Karumpoya and Muriat. Trees, however, were sold on kuttikanam from any block, at any time, whenever an application was made for them. In 1885, Colonel Campbell Walker proposed that these fellings should primarily be for the improvement of the growing stock. Nevertheless, even in the departmental fellings, marketable trees only were felled. In 1895, Mr. Lushington divided all the natural forests, except the New Amarampalam reserve, into twelve annual coupes and prescribed that generally all the trees of the marketable species, over 5′ 6″ in girth, might be cut without infringing the possibility. Such fellings were carried out up to 1904, over 10,000 logs being felled and removed, the greater number being sold standing to contractors. From this date, the fellings were practically confined to the removal of dead, top-broken and wind-fallen trees.

178. *Bamboo fellings.*—Timber and saplings, in this division, have always been floated green. To permit of rafting, bundles of bamboos have to be used as floats. From 50 to 150 bamboos are required per raft, according to the nature of the timber and the season of floating. The felling of bamboos dates from the introduction of departmental extraction in 1862. From the same date contractors and private merchants were permitted to fell and remove them, on kuttikanam, on demand. Though the areas, from which contractors and purchasers were to fell their bamboos, were generally stipulated by the District Forest Officer, no attempt was made to regulate the departmental fellings. Indeed, except subsequent to flowering, there is so much bamboo that the supply has been more than equal to the demand. The areas, which have been most regularly worked, are the natural forests adjacent to the plantations. In fact, such forests as Pokode and Kanakuth have been felled over

almost yearly. As they are unsuitable for rafting, one year old culms are never felled, while some of the older culms, owing to the thorny palisade, are generally so difficult to get at, that individual clumps even are rarely overworked.

SECTION 3—PAST SYSTEMS OF MANAGEMENT AND THEIR RESULTS, 1918–1928.

179. *General.*—In the first section of this chapter, reference has been made to the abnormal conditions which have operated against good management and development of the forests during the past decade Though Mr. Bourne's working plan has never been sanctioned, its prescriptions in respect of the existing teak plantations have been followed, more or less, and an attempt has been made to carry out part of his programme in the Conversion Working Circle (i.e., the accessible natural forests of the division). The execution of the work in each Working Circle will be described separately. A good deal of experimental sylvicultural work has been undertaken in recent years, and certain tentative positive results and definite as well as tentative negative results are available. The experiments will be described in a later paragraph.

180. *Plantation Working Circle.*—The teak final felling programme, as laid down in the working plan, got in arrears owing to the rebellion. It has now been brought practically up to date, though this was only achieved by felling about double the normal coupe in 1926—a questionable proceeding when the market was comparatively dull, and when so little success was being obtained in replanting clear-felled areas. Between 1918 and 1927 some 700 acres have been clear-felled and replanted with teak. Replanting has resulted in total failure on about 315 acres. Of these 315 acres of failure it is hoped to reclaim about 100 acres, for planting teak when the soil is restored. The remainder of the areas on which second crops of teak have failed, appear to be hopeless for the re-introduction of teak, at any time in the future. They should, however, support crops of other species after a lapse of years. On nearly 400 acres, second crops of teak have been established more or less successfully. But generally speaking the growth is poor (often miserable) and the stocking, in the later plantations, is also poor From 1919 to 1924, Mr. Bourne's method of regeneration was generally followed, except that certain compartments were allowed to lie fallow for a year, between felling and replanting. This innovation was not a good one, and was discontinued. Girdling the teak, a year before felling, has also been done in some compartments. This seems to promote the growth of grass and noxious weeds, and is probably almost as objectionable as allowing the area to lie fallow. In 1925, planting was delayed till late in the season because the nursery plants were thought to be too small. (Mr. Bourne stated that the smallest plants are the best.) The 1925 plantations are irregularly stocked, partly owing to late planting and partly owing to insufficient germination of teak seed in that year. In 1926, the method of regeneration was completely changed, and the plantations were raised by cultivators, in conjunction with field crops. The result was a disaster, and between 90 and 100 acres were utterly laid waste and have been abandoned. The same method was repeated in 1927, on an even larger scale. The total failure of 1926 was not repeated, but the average success of regeneration is only about 50 per cent, so that the replacement of casualties in 1928 will amount almost to reformation of the plantations. A considerable amount of time and money has been ill-spent in replacing casualties and weeding small plants for as many as five years after the year of formation. The 'mechanical' thinnings, prescribed by Mr. Bourne is second rotation crops, have been tried, but found unsuitable owing to the irregularity of the growth. The programme of ordinary thinnings fell into arrears owing to the rebellion, and fell still further into arrears during 1925 and most of 1926, in accordance with the general order of the Conservator that thinnings should be suspended, as the plantations were too open. This description was very true of the older plantations, but not of the younger crops, many of which are suffering from congestion. As regards execution, the thinnings, on the whole, have not been suitably carried out. Old plantations have been thinned too heavily, and young plantations too lightly, generally speaking. The degree of thinning in the present year (1927–28) appears suitable in most places, though in some cases the pendulum has swung too far, and the young woods, are being excessively opened out.

Until marking officers are allowed to remain long enough in the district to gain local experience, it cannot be expected that the difficult sylvicultural operation of thinning will be well done. Insufficient attention has been paid to climber-cutting in the young crops of the second rotation, to climber-cutting and removal of Loranthus in older plantations, and to the cutting of bamboos which tend to suppress the teak in various places. The working plan prescriptions in regard to these operations were rather vague, and have usually been passed over in the rush to complete more important works. In March and April 1926 practically all the plantations aged 20 years and over, were burnt departmentally. It is difficult for the writer to assess the results of the burn. He had practically no experience of the plantations prior to the burning, and his first impression, afterwards, was that a vast amount of the irregular undergrowth and of the scattered underwood of tree species had been destroyed, and that the growth of grass had been intensified, and such is undoubtedly the case. During all the time that he was engaged in describing compartments it appeared that the fire had been very harmful, even though regrowth was appearing from saplings which had been burnt back. But since completing the field work, the writer has noticed, on casual visits to the plantations, that seedlings of species such as Macaranga, Roxburghii and Trewia nudiflora are comparatively common in several grassy areas. He does not remember to have seen them before the fire, nor, to any appreciable extent, in the period between the fire and the monsoon of 1927. The origin of the fire needs some explanation. After inspection and consultation with the Inspector-General of Forests in 1925, the Chief Conservator ordered that a plan of burning and underplanting should be drawn up, for 1926 and subsequent years. Plantations over 60 years of age were to be burnt annually, with the object of inducing natural regeneration of teak which would kill the grass. (This has not happened, but the grass has usually become more luxuriant.) Plantations aged 20 to 60 years were to be burnt with the object of introducing artificial underwoods chiefly of Hopea parviflora. It was never intended that the plantations should be burnt except in the year in which underplanting could be undertaken. Further, it was intended that the fire should be a properly controlled, early fire. After the plan was sanctioned, it was represented to the Chief Conservator that a fire wood minimise the chances of successfully introducing Hopea, and the whole question was under correspondence until the time for controlled burning was long past. After much delay the burning programme was largely curtailed, but orders were too late in reaching the District Forest Officer, who set fire to practically all the plantations over 20 years of age, in the middle of the hot weather of 1926, when any control was out of the question. A certain amount of underplanting in the burnt areas was attempted in the ensuing monsoon, with very poor results. Some further burning was attempted in December 1926 and January 1927, but the undergrowth (where present at all) was too green for a fire to spread. The Chief Conservator prohibited further burning after an inspection in which he decided that more harm than good was likely to result.

Apart from the experiments of the Forest Research Officer, a considerable amount of work has been done, of recent years, in the way of attempting to introduce underwoods in the teak plantations. As far as it has been possible to trace localities and the species tried, reference has been made, to the work and results, in the description of compartments. Sowing and planting of the following species have been undertaken in various places:—Dendrocalamus brandisii, Hopea parviflora, Artocarpus hirsuta and integrifolia, Swietenia macrophylla (broad-leaved mahogany), rosewood, Terminalia tomentosa, Hydnocarpus wightiana, Macaranga roxburghii, Bombax malabaricum and Eriodendron anfractuosum. Cuttings of Carallia integerrima, Macaranga Roxburghii and Trewia nudiflora have been tried. Seeds of Glycosmis pentaphylla, diancha (Sesbania sp.) divi-divi, and castor have been tried, with the idea of introducing a shrubby undergrowth. In the most favourable localities, Hopea, mahagony and Hydnocarpus have met with some success. Failure, however, has been the rule in the case of underplanting. Unfavourable shade and climatic conditions, animal enemies, bad seed, and drip from the overwood, have all contributed to the lack of result. Lack of perseverence also, once the initial attempt was made, has played a large part in the general failure. The writer considers that the money wasted on planting evergreens in unsuitable localities could have been really well

spent if used in giving some practical assistance to existing seedlings of semi-evergreen or deciduous tree species. Mr. Bourne's prescriptions for the regeneration of the miscellaneous felling series (failed areas) have been largely ignored. Where failed areas have fallen within compartments due for felling and regeneration, they have been either cleared and planted with teak (which has failed once again) or else left untouched. In a few instances attempts have been made to stock such failed areas with other species, but the attempts have not been sustained, and have met with little or no success.

181. *Conversion Working Circle.*—In the Conversion Working Circle (25,100 acres) Mr Bourne placed all the more accessible of the natural forests. He proposed to convert them (with the exception of pure bamboo areas) to regular high forest, by means of artificial regeneration, as soon as possible, and at the rate of 400 to 500 acres a year during his working plan period. He prescribed the species to be grown —teak in all localities really suited to its growth ; rosewood on dry soils on a moderate scale ; Lagerstroemia microcarpa, Terminalia paniculata and Bombax malabaricum on dry soils, on a large scale ; Terminalia tomentosa on badly ærated soils ; Lagerstroemia Flos-Reginae in the worst swamps. All the chosen species were to be grown in pure woods, and conversion was to be restricted to teak planting, until experimental work has pointed out the best method of growing the other species. In the better forests not due for conversion for some time to come, selection (or revenue) fellings of the mature trees were prescribed. These revenue fellings were carried out in the first coupe only. Thereafter they were discontinued owing to the difficulty in extracting the outturn, in addition to the material obtained from areas cleared for plantations. Conversion has been attempted on some 940 acres, of which 680 acres are in the Amarampalam range. A description of each crop will be found in the appropriate compartment descriptions. Teak has been introduced on most of the clearings, miscellaneous species in a few. As in the Plantation Working Circle, the rebellion of 1921 and the floods of 1924 were responsible for much damage to the plantations of those years. Faulty selection of sites has been very common, many of the chosen areas being in localities of shallow laterite soil, or of a swampy tendency. The planting, however, seems to have been quite well carried out prior to 1924. In the later plantations the stocking is more patchy—partly due to the regeneration with field crops which was undertaken in parts of the 1926 and 1927 clearings. On the whole, the plantations in the Conversion Working Circle are poor, often very poor. Certain good areas are worthy of mention :—Mundakadavu, 1916 and parts of 1917, 1918 and 1919 plantations ; part of Nedungayam, 1919 ; part of Kanakuth, 1920 ; parts of Churlipatti, 1923 ; and a small area in Mundakadavu, 1926. Bamboos have been allowed to suppress the teak in parts of several young plantations. In the regeneration of teak, planting nursery seedlings has been the main method. Stump planting was undertaken in the 'ponam' areas of 1926–27. Direct sowing has been tried experimentally, and was very successful in 1926. Teak cuttings were planted after the destruction of the nurseries in the floods of 1924. They sprouted, but subsequently died. Of the other species introduced in the clearings of this Working Circle (all on a small scale) Bombax malabaricum and Eriodendron anfractuosum have been almost a total failure, largely due, it is believed, to browsing by deer and cattle. Terminalia tomentosa has been moderately successful in the 1921–22 area at Mundakadavu, where the survivors are growing well. Weed growth had to be preserved to reduce damage by browsing. In other localities where this species has been tried it has been less successful, but the results vary. Rosewood has been tried on a small areas in a number of the clearings, but owing to its slow growth in the initial stages, and to the fact that weeds have been preserved to protect it from deer, the percentage of success is difficult to determine. It has, at any rate, been partially successful in places. In 1926, about 7 acres were sown and planted with rosewood along with a crop of paddy, in Old Amarampalam. Casualties were replaced in 1927 with stumps of rosewood and Pterocarpus marsupium, and the percentage of success, in the cold weather of 1927, was 70 to 90. Some 7 acres of the same 'ponam' clearing were sown and planted with Pterocarpus marsupium in the same year. After replacement of casualties in 1927, the success is about the same as in the rosewood area. One year old rosewood stumps were planted in 1927, in various places and have been successful, so far. Attempts to grow Xylia xylocarpa, both by sowing and

planting, have been made in small areas in several of the clearings. In some cases the attempts have definitely failed. In others there is so much natural regeneration and regrowth of this species, that it is impossible to say what the results of artificial work has been (or why it was undertaken!) Other work with miscellaneous species will be described in the next paragraph.

182. *Experiments.*—As has been remarked already, a lot of experimental work has been undertaken in the past decade, and considerable expenditure has been involved. It is unfortunate, therefore, that there is no complete, continuous and reliable record of what has been done, and of observations on the apparent results. There is a register of experiments, opened in 1923-24, but it contains only seven entries, relating to experiments of that year. The only other record of experimental work undertaken by the District staff is to be found in the Forest note-book—a book whose maintenance is supposed to be discontinued for forests under working plans, and of whose continued existence probably only the District Forest Officer is aware. Here, too, the record is unsatisfactory and incomplete. Mr. G. C. Robinson took great pains to write up this book after the rebellion, from his own memory and from heresay. But even thereafter, many of the notes on experiments appear to have been written from memory, some considerable time after the work was done.

The work of the Forest Research Officer is on quite a different footing. This office was instituted in 1919, and it is very fortunate that the Nilambur division has had the benefit of a large part of the research that has been undertaken and is proceeding. All experiments have been properly recorded from their inception, and where they have been abandoned, the reasons for this course are on record. It would occupy too much space to copy, or to give extracts from every plot file, and this is unnecessary since all the information is available in the Forest Research office. In the circumstances, it appears most useful to describe such results as have been obtained, and to remark on possible future results. To avoid repetition of subjects, the work done by the District staff, the Forest Research Officer, and other officers, will all be considered together, for each species. There is bound to be some overlapping of information with what has been given already, in considering the Conversion Working Circle plantations and the underplanting of teak plantations, but it will be convenient to have all available information tabulated, species by species, for ready reference. It is to be understood that the conclusions drawn are those of the writer of this report, and not necessarily those of any other officer. The Forest Research Officer hesitates to formulate conclusions while his experiments are in their infancy, and he is quite correct. At the same time it is thought that the following discussion may be of some use to the management of the division, even if it be only to prevent expenditure on fruitless work. The species may now be considered in alphabetical order :—

Acrocarpus fraxinifolius.—Direct sowing, 6′ × 6′ and planting seedlings, 6′ × 6′ on shallow laterite soil under partially broken canopy of Xylia xylocarpa in natural forest.

Undertaken in 1927 by Forest Research Officer. Results awaited.

Albizzia lebbek—Direct sowing and planting in the open, on alluvial soil, in conjunction with field crops. Undertaken by the Forest Research Officer in 1926. Percentage of success in May 1927 was 43 per cent in the sown area, and 40 per cent in the planted area. (The former was within a fence.) Initial growth very slow. Subject to heavy browsing.

Artocarpus hirsuta.—Direct sowing, planting nursery seedlings, planting seedlings in bamboo tubes and planting stumps in the open and under shade, on laterite and alluvial soils. Germination is good both when seeds are sown direct and sown in nurseries, but rats and porcupines devour the seed if they can find it before it has time to germinate. The seedling is tender and requires careful handling. The species has so many animal enemies that total failure has been commen when it has been grown artificially. Rats, porcupines, squirrels and monkeys pull up the seedlings and eat the fleshy seeds (which remain attached for several months if not disturbed). When grown in the open or underbroken shade, seedlings which escape animal injury suffer heavy mortality in the dry weather. Browsing by cattle and deer, and mischievous breakage by monkeys are responsible for further damage to

such as still survive. For raising an underwood in teak plantations by the methods tried so far, the species cannot be recommended. The best result has been obtained (by the Forest Research Officer) in a teak plantation of 1922, where the aini was introduced in 1925. Casualties were replaced in 1926, by stumps, and 47 per cent survived in May 1927. Such success is exceptional. There is the possibility of success in an experiment undertaken by the writer in 1927, on shallow laterite soil, under the fairly heavy shade of old and middle-aged Xylia xylocarpa and some undergrowth, in a failed teak plantation. Both sowing and planting were undertaken with success. Damage to the seeds was slight, as the undergrowth was disturbed as little as possible, and animal enemies did not readily find the seedlings and plants. The hot weather has still to come. Planting of stumps by the Forest Research Officer has been partially successful, and is worth further experiment. (Growth is slow in early years whether from seedlings or stumps.) Stump planting would obviate damage to the seed (for the nursery could be guarded) and crops might be raised readily under shade, and possibly in the open, in this way, provided browsing could be minimised.

Artocarpus integrifolia —Has been tried under similar conditions as Artocarpus hirsuta. Results are even more disappointing in practically all cases. The species is even more popular amongst animals of all descriptions than is Artocarpus hirsuta. From the writer's experience, direct sowing, or planting of seedlings with the seed attached, appear to be impracticable, and as the seed remains attached for several months, it follows that seedlings should be a year old before transplanting. The Forest Research Officer has found planting of young plants successful at first, but monkeys have destroyed the leading shoots subsequently. When jack is grown in private gardens, the seeds are sown in baskets; the baskets are planted out, usually in the open, in the second year, and the seedlings are protected from cattle by fencing in some form or other. This method is successful but expensive. To test a local theory that jack will not bear stumping, the writer kept a few nursery seedlings in the bed from June till December, by which time the long tap-roots were about half an inch (or less) in diameter, at the thickest parts. He pruned the stems to about 2 inches and the roots to about 9 inches, and planted six such stumps in very dry laterite soil in the Circuit House garden at Nilambur. Being the dry weather, watering was required. The stumps were watered daily for two weeks, and thereafter at irregular intervals. All produced shoots, and five out of the six were doing well at the end of February, having developed healthy shoots and rootlets. It seems reasonable to suppose that a similar result would be obtained in the monsoon, without watering. Jack would probably grow better under moderate shade in early youth, though it certainly will grow in the open when one year old.

Bambusa arundinacea.—Direct sowing and planting of rhizomes on various soils. In June 1926 the Forest Research Officer sowed seed at stakes, 30 feet × 30 feet in a poor, grassy teak plantation, 40 years old. No preparation of the soil was undertaken, so as to avoid attracting rats and birds. A double handful of seed was scattered round each stake. An enumeration in the monsoon of 1927 showed that seedlings existed at 72 per cent of the stakes. The Forest Research Officer has also tried planting both cuttings and rhizomes. The latter method is successful, but too expensive on a large scale. Buds have also been planted but have been eaten by pig.

Bombax malabaricum.—Direct sowing and planting of nursery seedlings, both in the open and under teak plantations, on laterite and alluvial soils. There appears to be no great difficulty in raising this species, either by planting or direct sowing. But it is so heavily browsed by deer and cattle that total or partial failure has been invariable.

Calophyllum tomentosum (*syn. elatum*).—This species was tried by the Forest Research Officer, for underplanting an old teak plantation, in 1926. Owing to difficulty in getting germination only 18 seedlings could be planted. In May 1927, 15 of the 18 had died.

Dalbergia latifolia.—(There is some doubt as to whether the Nilambur rosewood is chiefly Dalbergia latifolia or chiefly Dalbergia sissoides.) Introduced in the open and under various shade conditions, on laterite and alluvial soils, by various methods. A considerable amount of success has been obtained, but results are very variabe,l

and early growth is slow—both seem to depend, to a considerable extent, on the incidence of browsing. Direct sowing in the open has usually given better results than planting nursery seedlings in the open. Planting under the broken shade of useless species, left after felling salable trees, has given good results, to date, in one of the Research Officer's plots of 1924, especially in the part which was fenced. Direct sowings under similar shade conditions are worthy of trial. Sowing and planting under teak have largely failed, possibly owing to drip from the large teak leaves. Sowing under moderate shade in natural forests has been tried, but no results can be given yet. Sowing on alluvial soil, in the open, in 1926, along with a field crop, has given very good results in the Forest Research Officer's compartment 120. (The area has had the protection of a fence and was ploughed in the year of formation.) Other good results from sowing in the open were obtained in the Conversion Working Circle clearing of 1926, on laterite soil (along with a field crop) in an area where browsing is not bad. Sowing and planting in the open, or round the edges of clearings for teak plantations, where no weeding has been undertaken, have given results which cannot yet be determined owing to the prevalence of weed growth. Some root-suckers were planted in the open in 1920, and were said to have given as good results as planting nursery seedlings. (As both have failed in this particular area, the foregoing is a safe statement!) One year old stumps have been planted in the open in various places, in 1927, and are promising, so far. A high percentage of success was obtained and the initial growth was often rapid. This method deserves further trial. It may well prove to be better than any other. When tried on failed teak areas of the second rotation, rosewood has been unsuccessful, up to date.

Dipterocarpus indicus.—Tried, for the first time, in 1927, by the Forest Research Officer, by transplanting seedlings 6 feet × 6 feet under natural forest of Xylia Xylocarpa on laterite soil. (Same locality as Acrocarpus fraxinifolius.) Results awaited.

Eriodendron anfractuosum.—Tried several times with Bombax malabaricum, and the same remarks apply.

Filicium decipiens.—Tried by the Forest Research Officer under an old teak plantation in 1927. Sowings failed. Results from transplants not yet enumerated.

Hardwickia pinnata.—This species has been planted in two localities by the Forest Research Officer. In 1926 it was introduced under the fairly heavy shade of mixed natural forest, with the object of converting the deciduous forest to evergreen. In May 1927, 65 per cent of the plants survived. Also in 1926, the species was planted under the shade of an old teak plantation (compartment 120) and 73 per cent survivals were counted in May 1927. (In the latter area there was already a good natural underwood.)

Hopea parviflora.—The introduction of this species particularly as an underwood in the teak plantations, has received a lot of attention at Nilambur in recent years. The writer has drawn the following conclusions from the work that has been done and his observations of the species growing naturally :—

(*a*) Hopea cannot be introduced, with reasonable success, in teak plantations which have not already got a moderately shady underwood or undergrowth, or both. (A *heavy* undergrowth is probably undesirable.)

(*b*) The value of Hopea, as an underwood, lies in very dense spacing (owing to its very restricted crown development under shade) and it is extremely doubtful whether this can be obtained in any but the few most favourable localities in the plantations of the present day, without incurring vast expenditure.

(*c*) The management must be prepared to plant, in even the most favourable localities, for three years, in order to get a stocking that can be considered satisfactory. Many of the natural forests, and failed areas in the teak plantations where there is a high proportion of Xylia Xylocarpa, contain areas where the shade conditions are suitable for establishing Hopea. The Forest Research Officer has found, after several years' experience of the species, that one year old transplants give the best results at Nilambur. Direct sowing would probably be a satisfactory method but it is difficult to get ripe seed at the proper time, i.e., just at the commencement of the monsoon, and further the seed has to be sown within a few days

of ripening. In 1927 the writer was able to get ripe seed just at the right time, and got very good results from direct sowing in a small area under the shade of a middle-aged forest, chiefly of Xylia Xylocarpa. Apart from the necessity of suitable shade conditions, the best results have been obtained on well-drained soil such as is found on laterite hillocks.

Hydnocarpus Wightiana.—Sown and planted under old and middle-aged teak plantations, on alluvial soil. First tried in 1926. The Forest Research Officer had 57 per cent to 68 per cent survivals, from sowing and planting in different plots, after the first hot weather. Sowings by the District staff in 1926 were a total failure, probably owing to collection of unripe seeds. Both sowing and planting were again undertaken by the District in 1927, and the planted seedlings look promising at present. This species is evergreen, gives a heavy shade, and is thoroughly at home on alluvium. It regenerates itself profusely in the natural forest, though it remains to be seen whether it will do so when growing as an understorey to the teak. It is worth further experiment, for it would be a very good underwood on alluvium, if its cost of introduction were low—as seems possible. As a timber it is worthless at present. The only present commercial value of the species lies in the use of the oil (extracted from its fruits) in the cure of leprosy. It is therefore unlikely to be directly remunerative.

Lagerstroemia Flos—Reginae.—Direct sowing and planting on good alluvium in the open, and on swampy alluvium and clay both in the open and under the broken shade of useless species left after felling marketable trees. Results variable, but often good. The present value of the timber is so low that there seems no object in raising the species artificially. Tried in a few instances on failed teak areas of the second rotation, where it has been unsuccessful so far.

Lagerstroemia microcarpa (*syn. lanceolata*).—Direct sowing and planting nursery seedlings on laterite and alluvial soils. Usually tried in the open (both with and without field crops), but occasionally under shade of varying degrees. Once it was found that fruits collected in the heat of the day had usually shed their seeds, no difficulty has been experienced in getting satisfactory germination. Planting, if carefully done (the seedlings are very tender), appears to give better results than direct sowing, though replacement of casualties is required many times in the first and second years. Introduction in the open, and under broken shade, appear to give equally good results. Results from introduction under moderate shade are awaited. The species is subject to heavy browsing, and initial growth is slow, partly due to this factor. Browsing is probably less under some kind of shade than in an absolutely open clearing. Attempts to grow this species on failed teak areas of the second rotation have, so far, been unsuccessful.

Macaranga Roxburghii.—Tried for the first time in 1927, with the object of raising an underwood, in old teak plantations, which would quickly kill grass and provide material for a burn on clear-felling the teak. Direct sowing by the District staff and by the Working Plan Officer was a complete failure—probably due to defective seed though the writer was convinced that his own seed was good at the time of sowing. Cuttings of various sizes were planted during the monsoon. All sprouted well but practically all have died subsequently. Late in the monsoon the Working Plan Officer planted some natural seedlings, removed from under a parent tree. Some success has been obtained, and had the operation been done early in the monsoon results would probably have been good. The species has no present commercial value, but it grows fast and is useful for killing grass. It is worth further experiment, with the object of finding a cheap means of raising the species.

Mangifera indica.—In 1923 and 1924, mango was planted under deciduous forest, in two localities, by the Forest Research Officer, with the object of converting the forest to the evergreen type. Three years after planting the survivals amounted to 25 per cent in one of the plots. In the other, two years after planting, the percentage of success was over 50. The plots have been abandoned owing to the comparative worthlessness of the species as a timber. Mango was also planted under a three-year old teak plantation in 1924, but the plot was destroyed by fire.

Mesua ferrea.—Seedlings transplanted by the Forest Research Officer under an old teak plantation in 1927. Results are very good so far. The species gives a

much heavier shade than Hopea and would never overtop teak. Further experimental underplanting is indicated.

Pericopsis Mooniana.—An exotic from Ceylon. First tried in 1927 by the Forest Research Officer, by underplanting in an old teak plantation on alluvial soil. Results awaited.

Pterocarpus Marsupium.—Direct sowing at stakes, broadcast sowing, and planting nursery seedlings and one-year old stumps, in the open. Laterite and alluvial soils. Germination good. Direct sowing at stakes probably preferable to planting. Broadcast sowings have failed. Subject to heavy browsing, otherwise early growth reasonably good. These remarks apply particularly to the work done in the 1926 clearing, to which reference has been made in the last paragraph. When the work has been done, experimentally, in failed teak areas of the second rotation, success has been slight. A word of warning about this species is necessary. It is an uncommon tree in the plains forests. It was raised in the 1904 plantation, both on deep disintegrated laterite and on poorly drained alluvium. Since 1918, practically all the trees on the laterite soil have died, and on the alluvium most of them are now dying or are very poor.

Swietenia macrophylla.—Much work has been undertaken in connexion with the broad-leaved mahogany, on all soils. The factors influencing its natural regeneration require further study. Burning undergrowth has induced a dense mass of seedlings in places, but these have mostly died in their first year. Where no burning has been done, dense natural regeneration is seen in places, scattered regeneration in others, no regeneration at all in many parts. The best natural regeneration is in places along the road from the Karumpuzha village to Chaliarmukku. Many of the avenue trees have produced a dense crop of saplings and seedlings. The densest growth was freed in 1926 by cutting bamboos and girdling trees which were overhanging the mahogany. The best saplings are up to 40 feet high, but all sizes are found. The area requires thinning. The use of this species in under-planting teak has been referred to, in the last paragraph. It is too early, as yet, to predict its future as an understorey to teak, but its introduction appears to be comparatively easy in many localities. Planting nursey seedlings has been the usual method. In 1927, the Working Plan officer sowed seeds direct at stakes, both in the open and under shade of varying intensity, from light to moderate, on shallow laterite soil. The sowing gave 100 per cent success—at least there was a mass of seedlings at all the stakes. The seedlings were thinned out, leaving three or four at each stake, and they are still doing well, at the end of February. It is believed that there is some variation in the germinative capacity of the seed, from year to year, but provided plenty of seeds are sown at each stake the Forest Research officer has found that direct sowing is preferable to planting. Grown in the open, both scattered and in small pure patches, forking, as the result of attack by a borer, is the rule, especially in the case of the scattered trees. In the patches of dense natural regeneration which have come up under shade, forking is not as yet seen to any appreciable extent. When introduced in failed teak areas of the second rotation, mahogany has, so far, been unsuccessful.

Tectona grandis.—Most of the recent treatment of teak has already been described in this and previous chapters. Experimental ploughing before the monsoon, in the year of forming second rotation crops, has caused undue surface wash. Ploughing after the monsoon has given good results in similar areas. The Forest Research officer has successfully introduced the method of 'notching' germinating seeds in several areas regenerated by him. (The seeds are soaked in water for 48 hours and put out in various places throughout the area, in small dumps, about the middle of April. Germinating seeds, or very small seedlings from the dumps are planted, in the monsoon, in holes made with a pointed stick.) The method is much cheaper than ordinary planting and the Forest Research officer is convinced of its reliability. The writer would like to see it tried on a much larger scale before recommending its general adoption—especially in the case of second rotation crops where very early establishment is of paramount importance. In 1927, the Forest Research officer took up a very poor, eight-year old, second rotation teak crop for experimental treatment, with a view to determining how the growth of such a plantation could be improved. Burning and cutting back, digging the soil, cutting and burning undergrowth, etc.,

were undertaken, and attempts were made to introduce Trewia nudiflora to form an understorey. The experiment must be carefully watched, for there are many second rotation crops which need artificial stimulus, if such is possible and practicable. In 1925, experimental plots in the new plantations of the year (second and first rotations) were manured in various ways—green leaf manure, cowdung, wood ash, nitrate of potash, etc. The only result recorded is a negative one, namely. that some of the teak was killed by excessive generosity with the nitrate of potash! In the same year bamboo mats were nailed to the ground (at considerable expense and probably no little trouble) in a small area, to keep down weed growth between the rows of teak. Experiments of this kind were quickly dropped, though it must be remarked, in passing, that at all events (to use a hackneyed phrase), every avenue has been explored.

Terminalia paniculata.—Many attempts have been made to raise this species artificially, but none have met with any appreciable measure of success as yet. Since 1918, or earlier, it has been realized that a large proportion of the seed of this tree is usually infertile. The discovery of a weevil in the fruit has already been mentioned, and there seems no doubt that the infertility is attributable partly, if not wholly, to this cause. It also appears that the percentage of infertility varies, from year to year. In 1924, when seed was sown direct in a clearing, it was reported that the percentage of germination was high. Such has never been the case before or since, when sowings have been undertaken either in nursery beds or in clearings. In 1926-27, the Working Plans officer sprayed selected trees once a week during the whole period of flowering and fruiting. Three quarters of a bag of ripe fruit were collected from the sprayed branches, and were sown in a nursery in May 1927, and watered 298 seedlings were raised in this way. He also collected four bags of fruit from trees which had not been sprayed; and sowed them very thickly at 361 stakes, near the end of May 1927. Two hundred and seventy-six seedlings resulted from the direct sowing of unsprayed seed. The results of the spraying experiment are inclusive, especially as the Forest Entomologist, Dehra Dun, now states that the spray used (arsenate of lead) was not a very good choice. During the monsoon of 1927 the writer got a complete stocking at these 361 stakes, partly from the germination of the seed sown direct and partly by planting the seedlings obtained from the sprayed seed in the nursery. The experiment was conducted on laterite soil both in the open, and under light and moderate shade in poor deciduous jungle. Soon after the monsoon, seedlings began to die. At the end of February 1928, only 48 per cent survived in the plot under moderate shade, 60 per cent under light shade and 9 per cent in the open. Further casualties are likely before the rains of 1928 begin. A high death-rate in the first hot weather has also been noticed amongst natural forest seedlings, where such have been observed by the writer, on small clearings. The seedling is extremely small and tender for at least a year. Unless spraying with an efficient mixture can be done economically, it would appear that a suitable way of raising this species would be to sow seed very thickly in nurseries (possibly under shade of some kind) and to tend the resulting seedlings during the first year, planting them out as year-old transplants. The meagre results of 1927 appear to indicate that planting under moderate or light shade would probably be preferable to planting in the open. The writer also experimented with cuttings, in 1927, but this was unsuccessful.

Terminalia tomentosa.—For its best development, the soil requirements of this species are similar to those of teak. Being less valuable than teak, it has not been cultivated on the best teak soils. Good growth is found on semi-swampy soils, and moderate to poor growth in really swampy localities. Artificial regeneration has usually been confined to soils which have been considered unsuitable for teak owing to defective drainage. Direct sowing, planting nursery seedlings, planting one-year old stumps, planting germinating seeds and planting seedlings in bamboo tubes, have all been tried at various times. The best method has not been decided. There appears to be no particular difficulty in raising the species artificially. It is, however, subject to severe browsing, and weed growth has often been encouraged in order to mitigate this evil. When grown in the open in Nilambur, heavy casualties from drought are to be feared in the first hot weather. Growing under broken shade, until the plants are well established, seems to be a suitable treatment. On

areas where teak has failed, owing to swampiness or flooding, and which have lain fallow for some time, attempts to raise Terminalia tomentosa have usually been unsuccessful. It is futile to attempt to grow this species on shallow laterite soils, though this has been tried on more than one occasion.

Trewia nudiflora.—This species is very common on alluvial soils, and is leafless for a very short time in the hot weather. (The new flush is common, early in January.) It is therefore suitable as an understorey in good teak localities. In 1927, it was introduced by the Forest Research officer in a poor teak plantation of the second rotation (aged eight years) after cutting and burning the undergrowth. Direct sowing, planting small nursery seedlings, and planting cuttings were all tried. The cuttings sprouted well, but most of them died in the dry weather. Direct sowings gave excellent germination, but a large proportion of the seedlings were killed by caterpillars, which ate the leaves and the tops of the tender stems. Planting gave poor results. Further experiments are most desirable.

Vateria indica.—First tried in 1927 by the Forest Research officer as an underwood in an old teak plantation. Sown direct at stakes and also planted in bamboo tubes. Results awaited.

Xylia xylocarpa.—This species has been sown and planted in clearings, in several places where the laterite soil has been considered too shallow for teak. On the areas chosen, natural seedling regeneration and regrowth of Xylia xylocarpa have usually come up in abundance, so the degree of success of artificial work is not ascertainable. The species forms a good natural underwood in many of the teak plantations, on laterite soils. With the object of introducing it as an underwood on alluvium, the Forest Research officer planted some seedlings in a one-year old teak plantation in 1927. Results are awaited. Since Xylia is never likely to overtop teak, except in areas where teak should not be grown, its value as an underwood is incontestable especially as its timber is valuable. Natural regeneration in teak plantations is to be encouraged and further research in artificial regeneration is desirable.

183. *Control records.*—None of the control records prescribed by Mr. Bourne has been kept properly for various reasons. In the first place, the working plan, with compartment registers, etc., was not received till 1922, when the first four years of the period had elapsed. Most of the information required for posting the arrears had by then been lost in the rebellion. Further, the prescribed compartment registers required such a volume of detail that they had the effect of frightening the management, and delaying the work of posting, though attempts were made, at various times, to post up the arrears. The annual record of yield has now been brought up to date, and is considered to be correct. The history of compartments has been re-written in a new form, and brought up to date, and it is believed that no important details have been omitted. The record of works has not been kept regularly, nor has the record of deviations from the working plan. Very few additions have been made to the silvicultural notes on important species, which Mr. Bourne prepared. The annual summary of revenue and expenditure has been brought up to date by the writer, and is incorporated in this working plan. In 1924, a register named the regeneration ledger was introduced. It provided for the monthly posting, for each area under regeneration or tending, the details of work done and expenditure incurred on each particular operation such as pitting, planting, weeding, etc. The posting of this register also was allowed to fall in arrears, until, towards the end of 1927–28, it was posted for three years back. Accuracy cannot therefore be expected in the details, though annual totals are probably correct. It is hoped that the control forms prescribed in this working plan will be found both simple and efficient.

184. *Costs of regeneration.*—The costs of exploitation have been considered in Chapter III, where it was pointed out that many of the present rates are excessive. The same criticism applies to regeneration costs. There is little uniformity in the costs of the various items from year to year, and from such records as are available, it is difficult to find the correct cost of formation per acre. From the entries recently posted in the regeneration ledger, it is seen that the total cost of formation (three years' work) of teak plantations raised in the normal manner, and not subject to abnormal conditions such as floods, has been Rs. 66 to Rs. 85 in the Plantation Working Circle, and Rs. 65–8–0 to Rs. 78 in the Conversion Working Circle. The respective costs in the first year have been Rs. 44 to Rs. 53–8–0 and Rs. 52–12–0 to Rs. 54–4–0,

respectively. It has been stated that recent costs, though higher than the working plan estimates, are not higher than the actuals incurred by Mr. Bourne on forming plantations. The writer is not satisfied with such a standard of comparison, even if recent plantations were as good as Mr. Bourne's, which they are not. He is convinced that good plantations can be raised at a lower cost, and especially when one considers the most unsettled conditions of the past decade it seems unlikely that he will be proved wrong. Consistent with achieving full stocking in the first year, and good growth from the start, it must be the immediate aim of the management to reduce the costs of formation.

185. *Protection.*—Protection of timber in transit, by the operation of the Timber Transit Rules, appears to have been efficient. Some amplification of the rules is now required owing to the opening of the new railway. As a safeguard against theft, more frequent inspections of outlying forests are probably desirable. Fire protection of the plantations, by means of an extensive net-work of fire-lines and employment of fire patrols, has been satisfactory. The modest expenditure incurred on fire-lines and fire patrols in the natural forest has afforded adequate immunity from fire.

186. *Elephant capturing.*—The pit-fall method of elephant capturing is adopted, and operations have been undertaken annually except during the rebellion. Operations are usually confined to the Amarampalam Range, though pits have sometimes been dug in the Edacode and Kanakuth blocks of the Nilambur Range. Between 1918–19 and 1926–27, 28 elephants were captured. In the 1927–28 season, three elephants have been captured up to the time of writing.

Section 4.—Special works of improvement undertaken.

187. *General.*—Since special works, of direct improvement to the forests, have been considered in describing past management, this section will be confined to communications, buildings and other works which have influenced the administration of the forests and the development of the locality.

188. *Forest roads and bridle-paths.*—None of the forest roads has been laid down as a metalled road. In one of them (the road from Nilambur to Mundakadavu) metal has been added, at various times, subsequent to formation, and in varying quantities as found necessary. Except where the road foundation is naturally very firm (e.g., on unweathered laterite) this kind of metalling is unsuitable for heavy traffic in wet weather. All other roads are earth roads pure and simple, and are repaired periodically by gravelling the surface and clearing the drains. The following is the list of roads, cart-tracks and bridle-paths, with years and costs of construction where ascertainable :—

Serial number.	Description.	Length.	Year of construction.	Cost of construction.
		M. F. CH.		RS. A. P.
1	Road from Calicut road to District Forest Officer's bungalow, Nilambur	0 5 0	1888-89	Unknown.
2	Road from No. 1 to Circuit House	0 2 0	1920-21	637 7 0
3	Bridle-path to District Forest Officer's bungalow .	0 2 11	1888-89	Unknown.
4	Bridle-path from District Forest Officer's bungalow to river	0 0 8	1888-89	Do.
5	Road from Areacode ferry to Arimbrakutta	1 3 0	1906-07	63 0 0
6	Bridle-path from Ramalaur to Edacode	2 2 0	Unknown.	Unknown.
7	Road from Old Amarampalam to Local Fund road, and diversion	1 4 0	Unknown. Diverted in 1925-26	Unknown. Diversion cost. 235 0 0
8	Road from Calicut road to Kuruvampuzhamukku ..	0 1 0	Unknown.	Unknown.
9	Do. to Chaliarmukku	1 1 0	1896-97	162 0 0
10	Do. to Mundayanthodumukku ..	0 4 0	1916-17	334 0 0
11	Do. to Aravallikava	0 2 9	1917-18	Constructed for the department by Nilambur Tirumalpad.
12	Do. to Edavanna Rubber Estate, passing through Moolathamanna and Pokode blocks.	Constructed by Edavanna Rubber estate. Forest Department has right of way only, and receives annual rent of Rs. 10.		
13	Road from Parambale road to Chanakundumukku ..	4 4 0	Road. 1900-01 Bridges. 1914-15	2,963 0 0
14	Road from Chanakundumukku to Mundakadavu ..	4 0 0	Road 1898-99 Bridges. 1911-14	5,847 0 0

Serial number.	Description.	Length.	Year of construction.	Cost of construction.
		M. F. CH.		RS. A. P.
15	Road from Mundakadavu to Kanhirakadavu	1 2 0	1899–1900	1,941 0 0 (for 15 and 16)
16	Bridle-path from Kanhirakadavu to Chappangam ..	1 6 0	1913–15	
17	Bridle-path from Chappangam to Mancheri	2 6 0	1901–02	296 0 0
18	Road from Palat (Gudalur road) to Nellicutta	3 3 0	1918–19	2,053 0 0
19	Road from Kanhirakadavu to Pulimunda	2 0 0	1917–18	1,118 0 0
20	Bridle-path from Mundakadavu to Nellicutta	2 0 0	Unknown.	Unknown.
21	Bridle-path from Mundakadavu-Kanhirakadavu road to the Punnapuzha via Padukka	4 4 0	1917–18	585 0 0
22	Road from No. 18 to Range Officer's quarters	0 1 4	1924–25	136 2 8
23	Road from No. 13 to subordinates' quarters	0 1 0	1925–26	54 11 0
	Total ..			16,485 4 8

N.B.—The total value of roads adopted in the commercial accounts of the Nilambur scheme is Rs. 16,516–5–2.

189. *Telephone line.*—The original telephone line was constructed in 1920–21, and provided communication between Mundayanthodumukku checking station, District Forest office, District Forest Officer's bungalow, Range office at Nedungayam, and Forest guard's quarters at Padukka. The line was destroyed in the rebellion. In 1923–24 it was re-erected, from the checking station to the District Forest office and thence to the District Forest Officer's bungalow and in 1926–27 it was extended to the new Range office at Karulai (Amarampalam Range). The line was installed, and is maintained, by the Telegraph Department, and is rented to the Forest Department for Rs. 675 a year.

190. *Buildings.*—The buildings in existence at present are insufficient for housing the existing staff whose headquarters are in Nilambur. The most crying need is for a bungalow for a second gazetted officer, and for quarters for clerks. In Amarampalam Range, the quarters built at Karulai, after the rebellion, are practically sufficient for the staff as it stands at present, though Government quarters for a peon are desirable. As stated already, many of the buildings in the division were destroyed or partially destroyed during the rebellion, and had to be re-built. The following is a list of the forest buildings, with dates and costs of construction and reconstruction :—

Serial number.	Description.	Year of construction.	Cost of construction.	Year of reconstruction or improvement.	Cost of reconstruction or improvement.
			RS. A. P.		RS. A. P.
1	District Forest Officer's bungalow, Nilambur	1890–91	14,379 0 0	1922–25	13,384 1 6
2	Range Officer's quarters, Nilambur	1896–97	1,815 0 0	1924–25	2,019 11 7
3	Forest guard's serambi, Arimbrakutta ..	1907–08	619 0 0	1923–24	509 15 10
4	Forest guard's serambi, Edacode	1917–18	439 0 0	..	..
* 5	Range Officer's quarters, Karulai	1924–26	4,898 0 11	..	..
* 6	Assistant Ranger's quarters, Karulai	1926–27	4,948 5 11	..	..
* 7	Two clerks' quarters, Karulai	1924–25	3,547 1 0	..	..
* 8	Four Foresters' and eight Forest guards' quarters, Karulai	1924–27	7,778 8 5	..	..
9	Assistant Ranger's quarters, Nilambur ..	1924–26	3,987 4 3	..	..
10	Foresters' quarters, Nilambur	1897–98	1,917 0 0	1925–26	37 0 0
11	Range office, Nilambur	1885–86	2,754 0 0	1923–26	1,271 14 4
12	District Forest office, Nilambur	1902–03	6,773 0 0	1924–27	7,144 6 6
13	Cordage shed, Nilambur	1911–13 and 1919–20	1,535 0 0	1924–25	419 10 6
14	Circuit house, Nilambur	1920–21	15,398 0 0	1922–24	3,471 0 6
15	Serambi, Kariem	1911–12	823 0 0	..	..
16	Serambi, Nellicutta	1914–15	814 0 0	..	..
17	Serambi, Old Amarampalem	1893–94	350 0 0	..	..
18	Serambi, Edacode	1897–98	671 0 0	..	..
19	Elephant kraal, Edacode	1919–20	922 0 0	..	..
20	Serambi, Kanakuth	1907–08	628 0 0	..	..
21	Checking station, Mundayanthodumukku ..	1916–17	486 0 0	..	..
22	Serambi, Karumpoya	1912–13	1,275 0 0	..	..
23	Serambi, Pulimunda	1913–14	1,437 0 0	..	..
24	Petrol magazine, Nilambur	1923–24	155 0 2	..	..
* 25	Range office, Karulai	1924–25	2,684 14 8	..	..
26	Rest-house, Nedungayam	1924–25	4,461 13 5	..	..
27	Provision store, Nedungayam	1905–06	832 0 0	1923–24	794 11 1
28	Subordinate's serambi, Nedungayam	1917–18	1,016 0 0	1923–24	757 14 9
29	Two elephant kraals, Nedungayam	1913–15	738 12 3	1922–23	748 13 9
30	Forest guard's serambi, Padukkal	1914–16	Unknown.	1926–27	610 1 4
	Total ..		88,082 13 0		31,169 5 7

* The cost of acquisition of land and clearing sites for the new buildings at Karulai amounted to Rs. 1,760–13–1, in addition to the costs quoted above. In other cases where land has been acquired, the cost of acquisition is included in the cost of building.

N.B.—The total value of buildings as given in the Commercial Accounts Balance Sheet, dated 31st March 1927, is Rs. 1,18,942–12–6.

191. *Wells.*—Wells have been sunk in the following localities :—

Nedungayam—one, year and cost unknown.

Karulai—two, in 1924–26, cost Rs. 1,414–0–11 and Rs. 995–8–6.

Kariem—one, year and cost unknown.

Arimbrakutta—one, year and cost unknown.

District Forest office compound—three, years and costs unknown.

Near District Forest Officer's bungalow—one, year and cost unknown.

The well at Karulai which supplies the Range Officer's and clerk's quarters, appears liable to fall in, as the foundations are insecure. If and when this happens, the desirability of sinking a new well somewhat nearer the quarters should be considered.

192. *Shoranur-Nilambur Railway.*—In 1927 the construction of a broad gauge line between Shoranur and Nilambur was completed. It puts Nilambur in direct railway communication with most of the important inland centres of timber consumption, and it is certain to play a most important part in the future development of the forests. Private timber merchants have been quick to take advantage of its facilities, and already the environs of the terminus are a hive of activity in hand-sawing of timber. Freightage on timber is high at present, but reduction of rates is simply a matter for negotiation with the railway authorities. Timber is the only commodity which can make the railway pay, and Government is the owner of most of the big timber in the neighbourhood. Some of the Government forests are within two miles of the railway station, and an extension of the line to bring it nearer to the main source of timber (the New Amarampalam Reserve) can probably be arranged as soon as an efficient organization for the large scale exploitation and regeneration of the forests can be built up.

193. *Saw mills.*—A small private saw mill is about to commence operation in Nilambur. With the advent of the railway the possibilities for saw milling and allied industries are enormous.

Section 5—Past yield.

194. *Yield from natural forests.*—"The outturn from sites, clear-felled for planting, are included under this head, whenever it has been placed upon record. From 1844 to 1862, no material from such fellings was measured. No other fellings were undertaken during this period, so that the present record dates only from 1862–63. During Mr. Ferguson's time, all timber felled was measured and departmentally extracted. The record from 1862 to 1884 is, therefore, complete. The total number of logs and their cubical contents is shown year by year. With Mr. Hadfield's advent, the outturn from most of the sites, clear-felled for planting, was sold standing. The number only of logs, removed by the contractor, have been recorded. Moreover, sale of standing timber on kuttikanam (stump fee) was also introduced with the same result. From 1885–86, therefore, two summaries are given: (1) of timber felled and measured and (2) of number of logs removed from trees sold standing. The data have been extracted from the original records and may be considered approximately correct." [R. Bourne.]

From 1918–19 onwards the numbers and cubical contents of logs and the numbers of bamboos, with the locality and year of felling, have been posted on loose sheets.

195. *Summary of annual outturn from natural forests.*—

(i) Total annual outturn from the Natural Forests in number and cubic feet species by species.

Year.	Teak.		Blackwood.		Logerstroemia microcarpa.		Terminalia tomentosa.		Terminalia paniculata.		Xylia xylocarpa.		Pterocarpus marsupium.		Hopea parviflora.		Adina cordifolia.		Miscellaneous.		Total.		Bamboos number.
	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	
1862-63 ..	430	5,239·32	30	444·18	522	10,080·37	81	1,649·33	136	2,617·61	37	852·84	..	..	..	..	2	53·49	..	..	1238	20,941·14	..
1863-64 ..	251	4,770·35	15	201·08	311	5,187·57	191	2,679·54	82	1,597·81	119	2,234·78	..	..	..	..	..	..	..	..	969	16,671·13	16,200
1864-65 ..	451	10,303·13	..	..	442	6,856·29	157	2,793·11	110	2,819 19	20	457·68	..	..	..	..	..	..	..	..	1180	23,229·40	9,300
1865-66 ..	15	393·80	9	205·25	508	9,903·60	199	4,835·80	172	4,451·47	166	2,848·78	..	..	..	..	..	..	..	..	1069	22,638·70	5,606
1866-67 ..	477	9,315·82	9	216·45	343	8,692·03	81	1,996·06	150	4,477·77	161	1,840·49	..	..	..	..	..	..	..	..	1221	26,538·62	8,409
1867-68 ..	No fellings.																						
1868-69 ..	68	1,789·32	14	167·74	103	2,245·55	68	1,196·41	8	171·74	11	208·96	..	..	..	..	..	..	..	..	272	5,779·72	2,622
1869-70 ..	417	6,649·96	22	511·17	307	8,491·87	35	1,295·58	..	..	..	..	..	..	..	..	..	..	..	..	781	16,948·58	2,766
1870-71 ..	224	3,711·50	8	123·50	410	11,713·00	33	724·50	..	..	..	..	..	..	..	..	..	..	..	..	675	16,272·50	6,265
1871-72 ..	[illegible]	7,506·35	24	672·22	398	11,305·67	154	4,283·50	7	234 50	281	7,363·39	..	..	..	..	..	..	..	..	1134	31,365·63	3,254
1872-73 ..	31[illegible]	6,059·90	13	278·31	86	2,391·60	32	1,229·50	83	853·95	..	..	..	..	..	..	..	..	5	66·75	531	10,880·01	21,921
1873-74 ..	39[illegible]	9,966·73	8	120·08	152	4,445·69	216	6,898 30	67	547·41	..	..	..	..	..	..	..	..	1	14·66	839	21,992·87	..
1874-75 ..	[illegible]74	5,116·88	1	8·84	109	5,039·70	394	18,677·40	..	..	..	..	..	..	..	..	..	..	..	..	678	28,842·82	..
1875-76 ..	[illegible]43	10,110·15	33	671·75	333	6,931·25	99	2,336·78	30	1,099·96	521	10,196·42	..	..	..	..	..	..	..	..	1459	31,346·31	..
1876-77 ..	[illegible]23	11,401·75	9	194·61	28	527·02	419	11,436·49	148	4,446·53	809	14,831·50	..	..	..	..	..	..	..	..	1836	42,837 90	..
1877-78 ..	895	17,801·23	11	262·73	920	24,742·16	346	8,384·85	40	883·84	241	5,352·46	..	..	..	..	..	..	..	..	2453	57,427·27	..
1878-79 ..	1	48·89	152	4,410·67	683	25,979·33	159	5,279·34	89	5,074 88	140	5,463·75	..	..	..	..	..	..	..	..	1224	46,206·86	9,157
1879-80 ..	1002	17,093·40	..	..	18	508·90	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1020	17,602·30	..
1880-81 ..	756	22,624·21	49	1,749·72	737	23,735·83	229	7,748·09	..	..	..	..	..	..	..	..	..	..	..	..	1771	55,857·85	..
1881-82 ..	..	..	11	489·58	244	9,102·58	25	1,042·49	..	..	133	6,335·66	..	..	..	..	..	..	..	..	413	16,970 31	..
1882-83 ..	545	17,321·44	27	804·32	487	18,681·26	119	4,492·64	63	2,324·60	136	3,442·67	..	..	..	..	..	..	..	..	1377	47,066·93	22,876
1883-84 ..	380	11,227·32	..	..	573	22,002·92	168	7,128·78	..	..	..	..	..	..	..	..	..	..	..	..	1121	40,359·02	10,1[illegible]4
1884-85 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6,850
1885-86 ..	301	12,774·00	13	663·00	187	10,195·00	252	14,320·00	..	..	..	..	..	..	112	6,968·00	27	3,002·00	180	10,582·00	1072	58,504·00	33,478
1886-87 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	28 268
1887-88 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	21,298
1888-89 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	17,464
1889-90 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	25,452
1890-91 ..	9	215·00	14	59·00	61	2,361·00	29	1,406·00	..	..	104	2,579 00	2	56·00	3	42·00	..	..	15	372·00	237	7,090·00	31,910
1891-92 ..	..	..	8	30·00	46	91·00	..	..	..	..	37	421·00	..	..	..	..	..	..	21	114·00	112	666·00	15,779
1892-93 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	30,544
1893-94 ..	117	3,696·00	97	2,738·00	620	21,703·00	189	6,413·00	274	5,112·00	302	3,171·00	21	651·00	..	..	33	1,315·00	409	5,486·00	2062	50,285·00	30,165
1894-95 ..	34	1,210·00	16	2,009·09	41	941·00	126	1,712 00	177	2,492·00	69	1,269 00	1	198·00	2	25·00	12	911·00	649	6,564·50	1127	17,331·59	16,639
1895-96 ..	554	16,764·34	84	2,460·09	1180	40,979·85	912	44,329·80	245	6,699·52	144	4,787·00	28	2,842·00	..	..	45	2,985·00	88	3,347·00	3280	125,194·51	43,050
1896-97 ..	488	8,075·00	27	673·15	1030	28,749·59	1111	25,292·77	112	2,403·00	343	9,881·66	12	407·00	..	..	25	1,404·37	188	5,765 00	3336	82,651·54	57,460
1897-98 ..	988	22,758·87	44	985·48	1234	38,772·41	1670	55,736·45	381	1,208·00	391	17,682·12	24	1,034·09	9	360·00	18	948·43	96	2,795·42	4855	142,281·27	64,017
1898-99 ..	857	22,227·38	109	2,071·92	1403	48 222·30	1041	40,816·17	154	7,624·80	169	6,583 66	26	1,029·21	1	240·50	36	1,827·32	116	5,822·36	3912	136,465·62	38,713
1899-00 ..	542	15,794·30	67	2,045·17	539	18,850·16	438	15,780·37	334	10,077·85	710	30,053·07	8	233·66	3	131·80	8	267·92	101	3,726 83	2750	96,961·13	7,692
1900-01 ..	508	8,820·29	43	1,020·66	274	11,038·11	428	21,599·57	1490	130,314·72	1131	38,827·21	38	928·09	12	865·22	..	..	312	11,655·00	4236	225,068·87	132,355
1901-02 ..	241	4,011·50	63	766 78	306	3,752·93	468	14,280·45	868	37,058·10	879	25,449·68	10	316 04	..	..	7	292 32	452	8,328 88	3293	94,256·68	101,689
1902-03 ..	123	1,992·65	8	143·56	339	9,240·08	139	3,806·09	2390	41,634·41	4402	74,616·99	22	456·97	1	18·37	26	532·70	391	9,909·66	7841	142,351·48	84,279
1903-04 ..	445	16,208·96	6	381·96	559	13,465·43	1283	24,326·65	2357	55,154·11	2537	64,487·46	1	39·00	4	35·24	1	11·81	464	15,036·80	7657	189,147·42	105,003

(i) Total annual outturn from the Natural Forests in number and cubic feet species by species—*cont.*

Year.	Teak.		Blackwood.		Logerstroemia microcarpa.		Terminalia tomentosa.		Terminalia paniculata.		Xylia xylocarpa.		Pterocarpus marsupium.		Hopea parviflora.		Adina cordifolia.		Miscellaneous.		Total.		Bamboos number.
	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	Number.	Cubic feet.	
1904–05 ..	288	8,854·81	90	8,581·35	639	33,147·75	607	18,401·53	1103	28,420·76	1740	78,067·64	4	522·38	..	..	7	661·34	238	8,883·43	4716	185,540·99	74,111
1905–06 ..	250	4,810·00	11	242·86	77	2,529·18	37	1,246·01	602	40,449·38	223	5,671·06	2	78·00	..	..	1	119·53	105	4,596·26	1307	59,742·28	59,807
1906–07 ..	695	9,035·97	35	455·00	346	8,771·90	154	5,541·17	529	2,116·00	252	1,660·61	..	..	..	..	12	508·64	177	4,583·65	2200	32,672·94	73,567
1907–08 ..	902	22,550·17	49	722·72	399	14,374·81	514	117,469·96	691	27,817·32	122	4,294·01	3	141·44	..	..	8	514·39	264	8,373·19	2942	196,258·01	109,217
1908–09 ..	963	8,329·10	83	896·54	201	3,841·30	352	13,660·94	122	25,223·88	362	13,248·31	4	132·78	3	82·91	7	156·72	193	3,619·66	2290	69,192·14	93,649
1909–10 ..	266	3,236·91	14	198·22	198	6,274·75	264	7,981·98	474	25,326·95	145	4,060·46	..	..	..	..	15	437·79	63	1,607·31	1439	49,124·37	16,810
1910–11 ..	2	113·45	2	53·78	..	..	..	..	..	..	4	91·03	..	..	..	..	..	..	..	..	8	258·26	57,643
1911–12 ..	9	376·64	1	32·94	4	198·99	9	514·42	3	604·35	45	1,387·57	..	..	..	..	..	..	..	..	71	3,114·96	50,514
1912–13 ..	1	18·90	..	..	9	262·47	..	..	..	..	13	179·37	..	..	..	..	..	..	..	..	23	460·74	94,417
1913–14 ..	39	848·34	3	76·68	24	808·56	35	1,247·12	..	..	31	1,194·66	..	..	..	..	..	..	2	44·72	134	4,220·08	51,580
1914–15 ..	35	1,235·82	1	42·24	10	513·49	64	2,776·99	32	1,796·15	53	1,699·81	..	..	..	..	18	587·56	120	2,175·15	231	10,827·21	50,822
1915–16 ..	38	1,930·56	..	..	4	247·26	7	430·75	19	813·23	5	223·26	..	..	..	..	..	..	1	172·12	67	3,817·18	61,813
1916–17 ..	6	195·26	..	..	10	358·63	17	1,285·60	89	7,538·58	36	1,645·87	..	..	..	..	..	..	3	133·44	161	11,257·38	63,250
1917–18 ..	3	87·74	..	..	12	322·03	..	..	9	307·34	401	6,562·43	..	..	..	..	..	..	26	333·85	451	7,613·39	127,555
1918–19 ..	176	2,814·33	68	1,014·56	259	7,443·48	109	3,082·92	908	43,372·38	1506	33,436·97	4	68·00	..	..	18	630·71	703	24,266·07	3751	116,129·42	359,733
1919–20 ..	492	11,767·74	61	936·80	371	11,971·72	95	2,930·79	1082	52,020·37	276	7,213·30	1	32·00	..	..	39	1,346·67	401	14,047·82	2818	102,267·58	306,855
1920–21 ..	406	9,502·76	38	934·39	364	10,723·12	314	9,770·32	770	37,132·93	414	9,405·96	..	..	..	..	10	339·07	394	15,064·80	2710	92,874·35	242,912
1921–22 ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1922–23 ..	230	5,273·15	34	820·36	391	12,749·58	88	2,383·07	949	48,435·08	588	15,151·31	..	..	..	..	..	..	398	11,188·04	2678	96,000·59	101,366
1923–24 ..	1455	17,652·48	20	306·64	451	11,539·05	72	4,696·05	1485	65,605·80	127	2,734·50	..	..	..	..	..	..	235	9,738·08	3845	112,272·60	105,724
1924–25 ..	47	1,016·00	18	396·00	356	10,785·00	45	1,979·00	1557	83,768·00	814	22,437·00	..	..	..	..	..	..	138	7,715·00	3975	128,096·00	139,838
1925–26 ..	97	2,787·00	23	451·00	147	4,818·00	57	1,795·00	737	33,782·00	679	17,368·00	..	..	..	..	..	..	7	84·00	1747	61,115·00	109,665
1926–27 ..	58	764·00	5	58·00	67	1,654·00	123	2,655·00	301	11,924·00	170	3,493·00	..	..	..	..	..	..	2	110·00	726	20,658·00	87,865

(ii) Total annual outturn from the Natural Forests in number (only) species by species.

Year.	Teak.	Blackwood.	Logerstroemia microcarpa.	Terminalia tomentosa.	Terminalia paniculata.	Xylia xylocarpa.	Pterocarpus marsupium.	Hopea parviflora.	Adina cordifolia.	Miscellaneous.	Total.
	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.	No.
1885–86	1,103	40	475	599	480	240	..	..	2	..	2,939
1886–87	103	147	448	57	4	248	..	..	..	520	1,526
1887–88	25	119	538	209	316	906	..	..	9	31	2,153
1888–89	6	172	418	210	46	472	..	..	4	162	1,490
1889–90	19	128	556	78	59	513	..	..	12	234	1,599
1890–91	732	32	76	528	1	..	111	..	3	348	1,831
1891–92	176	1	28	220	127	..	6	..	..	1,304	1,862
1892–93	362	119	541	301	133	417	3	..	..	1,663	3,539
1893–94	..	..	..	..	..	..	..	..	..	200	200
1894–95	39	125	205	327	177	..	8	2	9	48	940
1896–97	..	..	29	14	..	..	..	..	..	..	43
1898–99	..	..	..	49	..	127	..	..	..	..	176
1899–00	..	..	11	21	42	86	..	..	..	14	174
1900–01	1	..	..	..	..	..	1	..	..	..	2
1901–02	..	..	6	..	..	..	..	..	..	..	6
1902–03	..	..	128	55	1,214	3,086	..	..	..	255	4,718
1905–06	15	9	11	10	2	..	..	..	..	9	56
1907–08	99	..	22	56	37	36	..	..	1	9	260
1910–11	..	..	..	..	..	5	..	..	..	6	11
1911–12	..	..	4	..	..	..	..	..	..	..	4
1912–13	..	..	..	..	5	..	..	..	..	8	13
1913–14	3	..	..	..	..	14	..	..	..	1	15

196. *Yield from teak plantations.*—From 1852 to 1884, a record of the number of saplings felled in each plantation was kept As no measurements were recorded, Mr. Bourne omitted this record from his working plan. Annual records containing measurements of logs and classification of poles, felled in each plantation from 1888 onwards, were traced by Mr. Bourne, and were copied into the control records which accompanied his working plan. From 1918–19 to date, a complete record for each plantation has been maintained, and from 1923–24 to date, the yield from each compartment has been posted in the appropriate compartment registers as prescribed by Mr. Bourne. In writing the history and description of compartments for the present working plan, the yields have been recorded wherever separate figures, by compartments, have been obtainable.

197. *Summary of annual outturn from plantations*—

Summary of annual outturn from plantations

Year.	Teak logs in cubic feet.						Teak spokes and felloes in numbers of sets.	Logs of miscellaneous species in cubic feet.	Teak poles in	
	Above 8 candies.	6—8 candies.	4—6 candies.	2—4 candies.	Under 2 candies.	Short.			Measurables.	Superior small.
1888-89 ..	..	..	..	..	..	..	..	..	15,075·00	4,036·80
1889-90 ..	..	..	..	..	155·33	..	..	..	12,890·80	8,625·30
1890-91 ..	..	..	..	..	248·42	..	..	..	2,867·60	2,115·00
1891-92 ..	..	..	..	60·89	418·02	..	..	..	2,371·80	1,292·50
1892-93 ..	..	..	..	..	781·09	..	..	..	9,158 90	6,750·10
1893-94 ..	..	..	..	1,147 90	5,572·33	..	..	..	16,368·12	1,677·90
1894-95 ..	..	..	..	..	2,128·04	..	..	..	2,680 00	1,217·30
1895-96 ..	..	..	52·81	1,183·03	7,331·93	..	..	..	10,208·76	3,332·30
1896-97 ..	..	..	..	284·21	2,959,37	..	..	..	14,195·64	3,266·50
1897-98 ..	..	..	1,670·15	8,195·01	7,745·03	5·76	..	..	7,256·82	3,069·00
1898-99 ..	..	..	129·86	1,833·94	9,463,70	..	..	..	16,045·18	2,293·60
1899-00 ..	..	..	56·24	599·24	4,258·97	..	..	..	13,024·89	5,294·90
1900-01 ..	..	..	99·69	262·74	1,457·10	..	..	..	7,786·79	2,641·40
1901-02 ..	..	..	1,190·75	3,905·39	3,993·37	..	..	32·11	7,043·29	3,172·50
1902-03 ..	..	..	54·25	104·53	1,581·85	..	..	..	6,562·80	4,808·10
1903-04 ..	..	..	508·36	3,671·06	13,517·26	142·18	..	20·88	6,800·14	1,959·90
1904-05 ..	..	..	1,318·76	12,157·15	34,280·19	334·49	..	13·15	8,328·54	1,743·90
1905-06 ..	..	..	2,867·47	11,847·08	19,159·28	245·58	..	410·24	7,682·42	2,768·30
1906-07 ..	..	..	1,081·27	8,566·84	20,991 32	343·94	..	2,672·90	10,224·03	4,121·90
1907-08 ..	..	..	..	..	51,559·55	1,279 61	..	2,633·51	36,454·88	11,779·00
1908-09 ..	..	..	1,616·89	17,984·92	34,857·29	1,316 07	..	173·05	5,440·71	1,063·40
1909-10 ..	..	..	1,970·88	15,499·38	33,501·41	1,205·91	..	529·15	4,875·85	705·60
1910-11 ..	..	..	1,051·84	7,538·64	28,764·63	635·80	..	562·66	16,375·75	4,892·70
1911-12 ..	..	..	2,301·75	13,704·08	42,739·99	2,168·89	..	5,240·15	19,934·98	4,585·40
1912-13 ..	..	..	794·01	4,102·30	21,227·62	1,808·58	..	991·91	18,785·61	6,469 00
1913-14 ..	..	..	3,810·04	17,249·14	33,320·65	1,626·64	..	708·99	7,613·62	1,296·80
1914-15 ..	..	..	3,124·99	23,220·85	64,226·33	2,144·29	..	54·16	16,065·32	1,785·10
1915-16 ..	106·05	80·64	2,374·33	15,784·39	55,706·34	2,591·10	..	1,289·17	24,638·82	8,145·10
1916-17 ..	2,885·28	6,259·38	15,419·04	47,223·38	148,670·17	4,115·80	..	4,558·80	50,422·72	12,751·10
1917-18 ..	1,158·66	3,323·75	12,932·89	39,377·89	60,875·67	5,354·01	..	16,115·70	35,125·15	15,843·70
1918-19 ..	4,679·55	10,635 35	25,487·59	48,516·67	50,994·33	3,365·60	216	5,169·08	13,381·29	4,872·60
1919-20 ..	612·85	3,083·80	16,409 00	51,997·65	30,908·54	2,782·00	846½	355·06	2,643·77	1,715·50
1920-21 .. and 1921-22 ..	1,400·79	2,041·98	16,028·01	63,038·69	74,482·95	6,660·27	714⅚	420·87	16,330·69	4,366·30
1922-23 ..	2,535·07	9,894·33	2,584·81	80,761·40	72,372·39	16,927·41	..	2,223·58	18,706·00	8,568·10
1923-24 ..	445·86	2,270·06	9,429·19	32,691·08	55,393·50	12,912·22	473	3,289·52	24,517·76	7,477·70
1924-25 ..	2,794·00	7,996·00	27,395·00	60,670·00	54,583 00	7,862·00	185	706·00	19,421·26	9,263·70
1925-26 ..	1,619·00	8,431·00	30,519·00	74,918·00	50,786·00	10,262·00	180	489·00	4,792·00	32·80
1926-27 ..	2,902·00	11,942·00	48,332·00	128,782·00	95,246·00	22,358·00	..	1,955·00	10,204·00	1,639·70
Total ..	21,139·11	65,958·29	260,510·87	796,879·47	1,196,259·86	108,448·15	2,615⅓	50,614·64	522,301·70	171,440·50

(in cubic feet and in number).

cubic feet.							Total.
I class.	II class.	III class.	IV class.	V class.	VII class.	VIII class.	
4,947·10	11,325·10	4,198·60	2,404·50	1,120·05	287·10	124·00	43,518·25
11,938·40	17,485·30	9,782·20	3,042·00	1,203·30	806·30	2,669·10	68,599·03
2,922·50	3,926·10	4,944·00	3,603·00	965·30	1,070·30	3,165·10	25,827·32
1,330·00	2,446·60	3,648·40	2,774·75	3,761·55	358·60	610·70	19,073·81
6,044·50	7,642·90	7,866·60	4,178·25	1,242·00	766·70	1,223·90	45,654·94
1,694·10	1,280·92	700·00	374·25	4·95	300·30	2,557·50	31,678·27
1,249·00	1,576·30	1,355·20	923·60	1,433·25	821·70	1,243·70	14,627·99
3,888 50	6,617·10	7,651·20	5,177·20	2,875·40	1,117·50	635·50	50,071·23
3,794·00	3,162·50	2,058·00	977·10	2,214 90	514·80	821·50	34,248·52
7,336·00	12,797·20	13,734·00	7,851·60	1,623·50	3,262·20	1,955·00	76,501·27
1,547·90	1,071·70	382·20	308·20	1,033·70	595·10	1,286·50	35,991·58
4,403·00	1,858·40	897·40	168·50	20·10	1,289·20	2,681·50	34,552·34
2,793·00	3,535·10	5,015·40	3,317·90	1,030·30	1,426·70	598·30	29,964·42
3,458·00	2,934·50	2,996·90	5,262·70	4,102·90	3,656·40	1,797·80	43,546·61
9,422·00	13,687·30	7,808·40	4,234·20	2,735·70	4,175·60	3,661·10	58,835·83
1,606 50	1,246·60	693·00	314·30	1,040·50	1,181·70	1,339·20	34,041·88
1,459·50	685·40	162·40	17·90	3·10	477·40	1,677·10	62,658·98
3,377·50	4,774·80	3,096·80	1,564·00	340 00	3,405·60	936·20	62,475·27
4,259·50	3,712 20	2,239·00	1,982 90	491·20	1,187·10	1,397·30	63,272·00
11,969·00	7,350·50	3,182·80	1,395·90	380·20	1,724·80	3,072·10	132,781·85
719·50	418·60	457·20	1,570·30	1,935·90	894·30	1,091·20	69,539·33
588·00	407·10	245·00	134·50	22·40	203·50	1,205·90	61,094·58
5,605·70	8,270·80	6,007·40	3,183·70	482 20	3,350·60	2,402·50	89,124·92
6,478·50	8,436·40	9,059 40	4,610·95	639·40	6,623·10	3,817·60	130,340·59
6,646 50	7,035·70	5,856·20	3,763·90	954·20	7,219·30	2,995·20	88,650·03
1,837·50	3,833·00	7,134·30	8,183·70	3,204·40	3,724·70	1,212,10	94,755·58
1,690·50	1,545 60	1,426 70	1,190·90	442 70	713·10	2,024·30	119,654·84
12,404·00	13,505·60	12,460 00	9,940·30	3,551 00	11,216·70	3,301·50	177,095·04
13,573·00	13,349·20	11,634·00	6,636·50	1,863·40	8,476·60	5,149·10	352,987·47
25,935·00	29,141·00	22,283·80	13,402·50	2,353·00	13,286·90	5,518·00	302,027·62
9,968·50	15,071·20	16,533·90	14,083·95	2,313·26	12,930·50	2,707·20	240,210·57
4,914·00	9,954·40	8,937·60	5,737·50	2,667·30	3,270·30	750·20	146,739·47
6,718·00	10,796·20	7,427·00	4,233·00	1,595·75	7,811·10	2,836·50	226,188·10
12,575·50	14,724·60	10,516·80	5,664·00	785·22	5,098·50	7,055·60	300,993·31
9,614·50	8,959 50	4,582·20	2,189 25	979·26	10,146·40	7,471·00	192,369·00
8,463,00	6,127·20	3,347·40	2,338·75	1,578·72	7,237·20	7,201·30	226,984·53
77·00	20·70	5·60	1·50	..	1,813·90	6,274·40	190,041·90
2,726·50	3,036·00	3,457·80	4,636·50	2,920 80	5,000·60	11,962·90	356,471.80
219,975·10	263,749·42	213,785·80	141,374·35	55,280·81	137,442·40	107,929·60	4,333,190·07

Section 6—Past Revenue and Expenditure.

198. *General.*—All the figures of revenue and expenditure, prior to 1918–19, have been taken from Mr. Bourne's working plan. His tables and his sources of information may be explained in his own words: "No detailed cash accounts are available prior to 1863. The sole details of expenditure, available for this period, are monthly statements of works upon which the coolies were employed. Even so these statements are far from complete. The summaries of revenue and expenditure for this period are based upon a statement prepared by Mr. Ferguson. From certain details given in the inward and outward letters of the Forest Department, it is clear that this statement is not always correct. For the years in which details have been traced, corrections have now been made. From 1863–64, the original cash books have been abstracted and checked in every possible way. In the case of revenue, it has only been possible to classify, separately, receipts on natural forest timber, bamboos, plantation logs and poles, fuel and miscellaneous items. In the case of expenditure, charges have been more elaborately classified. All data, now given, refer only to areas covered by the present plan. The totals, therefore, do not tally with returns for the whole division. Great care has been taken in the preparation of the present summaries and, though they are certainly not absolutely correct, they claim such accuracy as it is now possible to achieve. An attempt was also made to classify the past revenue and expenditure, under each head, area by area. In many instances there was no difficulty, but, in many others and even for recent years, so many items have been clubbed together that both accuracy and completeness could not be attained. In the circumstances, none of the results achieved are now placed on record."—*R. Bourne.* The figures from 1918–19 onwards have been obtained from various sources. The destruction of records in the rebellion has complicated the task of compiling statistics. It is believed, however, that the figures given below are tolerably correct. Most of them have been abstracted from the registers of the Nilambur division. Figures pertaining to the period prior to the rebellion have come from the VI Circle office, and certain corrections (as, for example, in the case of the sales of elephants belonging to other divisions) have been made after reference to other District Forest Officers. It has been found impossible to separate certain items of revenue and expenditure pertaining to Mannarghat range from the totals for the division, as the Mannarghat range records also were lost in the rebellion. The inaccuracy thus caused is, however, trifling.

199. *Summary of past revenue*—

Year.	Revenue from					Total.
	Timber from natural forests and planted sites.	Bamboos.	Teak from plantations.	Fuel.	Miscellaneous items.	
	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1842–43 ..	452 3 2		..	..	23 4 6	475 7 8
1843–44 ..	..		..	..	..	..
1844–45 ..	12 14 0		..	..	..	12 14 0
1845–46 ..	..		..	..	..	..
1846–47 ..	..		..	..	..	..
1847–48 ..	..		..	..	..	..
1848–49 ..	767 1 8		..	..	..	767 1 8
1849–50 ..	416 0 0		..	..	11 0 0	427 0 0
1850–51 ..	444 8 5		..	..	..	444 8 5
1851–52 ..	811 12 0		..	..	7 6 6	819 2 6
1852–53 ..	4,459 12 9		..	..	326 0 0	4,785 12 9
1853–54 ..	519 9 11		..	5 8 0	161 14 6	687 0 5
1854–55 ..	320 9 8		..	5 8 0	176 14 6	503 0 2
1855–56 ..	295 1 11		..	..	4 6 6	299 8 5
1856–57 ..	257 8 0		..	..	..	257 3 0
1857–58 ..	854 3 1		..	..	..	854 3 1
1858–59 ..	1,768 13 6		..	..	..	1,768 13 6
1859–60 ..	5,717 2 9		..	..	..	5,717 2 9
1860–61 ..	4,615 6 8		..	..	..	4,615 6 8
1861–62 ..	808 0 0		..	..	..	808 0 0
	RS. A. P.	RS. A. P.				
1862–63 ..	5,495 0 0	176 0 0	12,043 0 0	..	8 14 10	17,722 14 10
1863–64 ..	4,279 0 0	1,193 4 0	2,160 0 0	..	8 14 2	7,641 2 2
1864–65 ..	9,447 0 0	774 0 0	16,776 0 0	..	161 11 10	27,158 11 10
1865–66 ..	4,585 14 0	719 13 11	9,306 8 0	..	9 4 0	14,621 7 11
1866–67 ..	10,032 0 0	736 0 0	15,647 0 0	..	591 5 7	27,006 5 7
1867–68 ..	2,595 0 0	..	500 0 0	..	2 0 0	3,097 0 0

Year.	Revenue from.					Total.
	Timber from natural forests and planted sites.	Bamboos.	Teak from plantations.	Fuel.	Miscellaneous items.	
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1868-69 ..	6,163 12 8	661 11 8	8,986 14 11	.	93 14 6	15,906 5 9
1869-70 ..	6,029 13 8	297 10 8	2,886 13 6	..	1,240 0 0	10,454 5 10
1870-71 ..	9,894 0 0	573 0 0	5,541 10 8	..	41 5 4	16,050 0 0
1871-72 ..	7,235 14 0	309 12 10	843 5 9	..	119 11 11	8,508 12 6
1872-73 ..	7,805 9 2	1,703 6 11	7,378 14 0	251 8 0	6 4 0	17,145 10 1
1873-74 ..	19,402 4 3	..	4,846 8 0	..	63 11 3	24,312 7 6
1874-75 ..	2,306 9 8	14 0 9	2,313 11 10	..	9,796 8 11	14,430 15 2
1875-76 ..	670 14 2	..	12,946 12 5	..	6,272 0 3	19,889 10 10
1876-77 ..	26,818 4 9	..	5,020 11 9	..	1,192 2 8	33,031 3 2
1877-78 ..	2,385 14 9	..	20,129 3 8	..	..	22,515 2 5
1878-79 ..	2,013 13 2	..	31,771 10 11	..	419 10 8	34,205 2 9
1879-80 ..	12,131 11 10	15 10 0	..	3,526 7 0	9,210 13 2	24,884 10 0
1880-81 ..	11,015 0 0	1,040 1 6	51,930 3 1	..	176 1 2	64,161 5 9
1881-82 ..	..	8 0 0	49,687 3 1	30 0 0	20 7 0	49,745 10 1
1882-83 ..	16,606 1 9	..	14,371 1 7	..	1,762 3 2	32,739 6 6
1883-84 ..	10,280 12 7	..	42,174 3 6	1,587 15 0	1,051 0 0	55,093 15 1
1884-85 ..	..	..	..	2 0 0	..	2 0 0
1885-86 ..	1,998 12 0	2,060 0 5	76,430 15 0	46 0 0	602 0 0	81,137 11 5
1886-87 ..	9,810 6 8	713 7 2	6,917 4 10	..	279 3 5	17,720 6 1
1887-88 ..	6,180 13 8	1,214 9 3	32,174 13 8	..	2,815 6 0	42,385 10 7
1888-89 ..	8,997 3 8	233 11 4	30,868 7 5	..	1,368 8 10	41,467 15 3
1889-90 ..	8,488 9 0	1,110 6 10	26,831 7 6	382 2 6	1,287 6 5	38,100 0 3
1890-91 ..	10,445 12 10	1,722 12 4	29,705 14 7	1,137 2 0	1,763 7 10	44,775 1 7
1891-92 ..	14,216 14 10	952 3 1	23,876 1 2	157 4 11	3,566 3 6	42,768 11 6
1892-93 ..	21,342 2 10	1,611 10 4	14,601 13 6	204 14 4	4,667 8 5	42,428 1 5
1893-94 ..	32,956 15 2	30 0 0	33,073 3 11	580 7 3	6,071 13 6	72,712 7 10
1894-95 ..	21,289 5 7	566 14 8	28,566 2 0	545 9 2	11,552 12 8	62,520 12 1
1895-96 ..	12,879 2 7	1,085 0 9	6,955 5 6	351 4 0	15,972 13 9	37,243 10 7
1896-97 ..	26,845 7 2	637 1 4	20,325 8 0	786 8 0	31,812 0 4	80,406 8 10
1897-98 ..	27,500 15 3	6,664 1 10	42,321 4 6	120 3 1	19,409 3 10	96,015 12 6
1898-99 ..	37,465 9 10	8,863 11 0	10,064 2 2	44 15 0	4,267 3 0	60,705 9 0
1899-00 ..	28,938 6 3	1,048 3 8	37,654 13 1	838 4 4	8,467 0 3	76,936 11 7
1900-01 ..	1,97,634 15 1	750 0 0	20,681 3 10	978 11 8	8,621 7 0	2,28,666 5 7
1901-02 ..	57,851 3 3	2,966 0 6	18,081 1 2	9 0 0	8,349 15 2	87,257 4 1
1902-03 ..	15,919 11 3	2,458 9 3	37,888 12 9	100 0 0	4,377 12 1	60,744 13 4
1903-04 ..	18,023 4 1	2,206 13 1	15,858 15 7	4,408 2 2	10,935 10 5	51,432 13 4
1904-05 ..	23,863 0 9	978 2 11	27,045 13 0	9,348 14 10	6,180 15 6	67,416 15 0
1905-06 ..	15,363 1 9	2,383 3 8	26,797 5 4	3,037 12 4	11,105 4 3	58,686 11 4
1906-07 ..	12,734 5 3	291 0 0	1,20,069 1 10	2,460 10 9	12,350 4 6	1,47,905 6 4
1907-08 ..	7,735 6 2	2,974 9 9	79,767 13 2	213 0 1	4,025 14 11	94,716 12 1
1908-09 ..	18,308 5 10	5,262 9 0	1,07,995 3 10	139 5 10	8,536 13 8	1,40,247 6 2
1909-10 ..	22,317 3 1	4,1[illegible]3 12 4	1,16,635 8 1	37 6 1	5,189 0 2	1,48,292 13 9
1910-11 ..	14,523 1 2	3,127 12 2	68,894 0 5	78 0 6	6,139 10 5	92,762 8 8
1911-12 ..	2,436 6 1	4,725 2 8	96,514 7 9	147 3 1	10,516 6 10	1,14,339 10 5
1912-13 ..	750 13 9	5,206 9 7	1,30,514 3 6	209 5 2	4,666 0 2	1,41,347 0 2
1913-14 ..	1,670 4 11	5,028 12 3	71,105 1 8	251 12 2	16,764 13 4	94,820 12 4
1914-15 ..	3,636 3 3	3,008 7 9	1,00,365 14 9	794 13 3	19,532 11 6	1,27,338 2 6
1915-16 ..	1,678 9 6	7,449 4 8	1,35,147 9 8	161 0 0	5,207 11 10	1,49,644 3 8
1916-17 ..	1,472 7 9	3,866 10 2	1,56,751 11 6	233 12 2	7,543 3 10	1,69,867 13 5
1917-18 ..	1,105 9 11	8,858 10 0	3,99,466 8 2	1,299 5 7	22,105 11 4	4,32,835 13 0
1918-19 ..	11,554 4 11	11,155 12 2	3,58,186 7 4	392 9 7	* 26,020 0 0	4,07,309 2 0
1919-20 ..	41,570 12 2	23,391 5 6	6,21,809 8 7	302 2 0	* 5,400 0 0	6,95,473 12 3
1920-21 ..	77,054 6 6	14,119 1 11	3,79,470 10 11	684 12 0	* 18,552 15 4	4,89,881 14 8
1921-22 ..	49,535 0 0	3,762 8 0	1,22,720 1 4	91 8 0	6,389 14 2	1,82,498 15 6
1922-23 ..	37,187 2 7	13,622 1 0	1,69,785 8 2	578 14 0	4,838 1 4	2,26,011 11 1
1923-24 ..	26,942 12 9	9,352 10 8	2,19,782 3 4	216 15 6	7,387 8 3	2,63,682 2 6
1924-25 ..	18,892 15 8	11,146 11 2	2,65,840 2 11	349 13 2	5,286 2 1	3,01,515 13 0
1925-26 ..	1,02,385 1 1	7,306 13 0	2,95,187 12 4	157 4 6	9,125 3 2	4,14,162 2 1
1926-27 ..	60,105 6 10	13,268 5 9	3,38,316 0 9	290 12 0	5,615 9 8	4,17,596 3 0
Total ..	15,23,846 7 9		52,38,307 13 2	37,576 7 0	4,07,616 7 7	72,07,347 3 6

* Revenue from Mannarghat range (Palghat division) also included, as it is impossible to get details owing to destruction of records in rebellion.

200. *Summary of past expenditure*—

Year.	Costs of acquisition and lease payments.	Cost of conservancy and exploitation.					
		Regeneration operations.	Tending and maintenance.	Fire protection. †	Exploitation.		
					Timber and saplings.	Bamboos.	Live-stock.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1840-41 ..	8,000 0 0	..		..	..	..	..
1841-42 ..	..	1,676 5 0		..	..	..	..
1842-43 ..	98 0 0	990 2 0		..	..	..	.
1843-44 ..	..	1,251 10 7		..	..	..	..
1844-45 ..	..	1,430 0 2		..	..	..	..
1845-46 ..	..	1,169 5 0		..	..	..	..
1846-47 ..	..	1,395 15 0		..	..	..	..
1847-48 ..	..	1,488 12 11		..	..	..	..
1848-49 ..	..	1,477 14 7		..	..	..	..
1849-50 ..	..	1,443 13 11		..	..	..	..
1850-51 ..	..	1,698 3 1		..	..	..	..
1851-52 ..	..	1,094 15 1		..	..	..	..
1852-53 ..	..	2,802 2 8		..	..	..	..
1853-54 ..	..	1,418 10 11		..	..	..	..
1854-55 ..	..	1,544 0 11		..	..	..	..
1855-56 ..	..	1,130 4 2		..	..	..	..
1856-57 ..	..	1,454 14 0		..	..	..	..
1857-58 ..	114 12 0	1,083 15 3		..	..	..	..
1858-59 ..	..	608 10 10		..	..	..	..
1859-60 ..	323 6 4	1,872 0 9		..	..	..	..
1860-61 ..	..	1,167 4 7		..	..	..	..
1861-62 ..	..	2,039 5 6		..	..	..	..
1862-63 ..	..	3,753 3 5		..	..	..	..
1863-64 ..	..	2,670 4 8			3,797 7 9	545 8 0	994 8 3
1864-65 ..	..	5,872 9 10		..	4,430 15 5	169 5 1	1,077 7 10
		RS. A. P.	RS. A. P.				
1865-66 ..	..	354 14 0	5,957 6 5	..	4,038 0 2	241 0 10	451 6 9
1866-67 ..	..	296 6 0	4,918 1 7	..	1,152 1 1	215 9 6	1,254 2 4
1867-68 ..	..	641 14 0	6,782 13 8	..	1,112 1 5	100 0 0	..
1868-69 ..	..	638 4 0	5,767 1 7	..	3,129 12 9	119 15 3	..
1869-70 ..	2,862 15 2	1,194 12 5	4,287 11 3	..	1,819 7 10	24 0 1	..
1870-71 ..	200 11 7	708 11 4	6,601 1 4	..	6,416 0 11	216 6 2	..
1871-72 ..	5,200 0 0	1,807 1 4	4,582 14 8	..	6,583 1 6	352 3 7	..
1872-73 ..	80,000 0 0	3,964 3 6	4,584 7 10	..	6,823 14 4	1,213 14 5	..
1873-74 ..	2,318 8 10	5,454 10 8	4,734 12 11	..	6,213 10 10	929 2 2	..
1874-75 ..	102 0 0	5,964 11 6	3,306 2 8	..	6,641 1 9	811 1 10	..
1875-76 ..	100 0 0	4,418 2 9	3,546 8 0	..	8,831 10 5	909 13 1	..
1876-77 ..	100 0 0	900 9 0	5,206 9 6	..	9,173 4 11	353 7 8	..
1877-78 ..	100 0 0	396 7 0	4,343 8 0	..	7,236 12 6	612 0 6	..
1878-79 ..	1,636 8 11	..	5,003 5 6	..	7,454 15 5	443 3 7	..
1879-80 ..	779 1 6	196 15 0	5,845 10 11	..	9,056 6 11	862 2 8	748 5 8
1880-81 ..	220 14 0	24 12 0	3,838 6 0	..	8,695 5 10	513 7 2	331 12 8
1881-82 ..	1,100 0 0	..	5,185 8 0	..	9,581 1 5	472 8 0	1,511 0 1
1882-83 ..	2,020 9 7	..	2,960 8 0	..	8,834 14 3	624 13 5	678 7 5
1883-84 ..	1,277 11 3	..	3,549 14 0	..	7,343 13 9	865 10 6	906 4 10
1884-85 ..	100 0 0	..	3,795 10 0	..	8,026 0 9	542 13 6	1,222 10 0
1885-86 ..	3,062 13 10	693 12 6	2,771 6 6	..	15,678 2 9	533 14 2	2,587 10 3
1886-87 ..	1,053 4 0	2,512 4 3	3,331 11 0	..	8,643 10 6	975 5 11	3,686 15 0
1887-88 ..	687 12 8	2,532 12 6	3,379 0 6	..	3,857 3 4	313 5 7	3,518 8 6
1888-89 ..	42,676 5 6	3,818 12 6	4,691 3 0	..	4,721 11 11	408 9 2	5,770 1 4
1889-90 ..	444 3 11	4,660 8 0	2,820 0 6	..	4,671 0 8	402 13 3	5,024 3 4
1890-91 ..	473 12 4	2,924 12 2	5,992 13 9	..	7,120 2 8	606 14 9	3,961 1 10
1891-92 ..	1,530 12 2	3,949 5 0	5,680 11 6	..	4,477 13 10	146 14 6	3,368 15 2
1892-93 ..	4,375 1 7	3,570 10 6	6,653 11 0	..	5,332 14 2	130 9 2	6,316 6 0
1893-94 ..	1,050 7 1	1,859 15 0	6,454 0 3	..	5,446 7 2	295 11 0	5,701 13 5
1894-95 ..	1,082 7 11	498 5 0	6,496 15 11	..	3,238 6 4	485 10 0	10,859 2 1
1895-96 ..	3,673 4 3	..	6,025 0 10	..	5,161 1 10	378 13 4	8,794 1 0
1896-97 ..	5,255 11 6	2,025 8 6	2,093 15 0	..	13,677 6 5	37 3 8	6,407 3 8
1897-98 ..	556 5 8	2,941 4 0	5,323 5 6	..	9,886 10 5	1,199 4 0	7,579 14 4
1898-99 ..	490 10 9	2,486 0 6	5,036 4 6	..	10,678 10 1	1,184 3 4	8,659 2 0
1899-00 ..	..	3,641 8 0	4,757 7 0	..	8,967 7 4	1,979 4 10	9,628 8 6
1900-01 ..	900 10 1	4,854 0 6	6,094 10 5	..	40,962 13 10	4,330 3 10	9,471 12 8
1901-02 ..	3,941 14 9	3,891 1 3	6,080 10 0	..	8,333 8 1	598 2 7	8,181 4 11
1902-03 ..	5,461 10 4	4,505 7 0	6,352 3 6	..	5,821 5 1	838 10 3	9,472 12 7
1903-04 ..	2,820 10 3	3,074 15 6	4,236 5 10	..	6,021 15 8	1,442 8 2	10,690 9 2
1904-05 ..	6,303 12 6	3,164 7 8	5,031 10 8	..	10,458 2 5	1,295 0 7	10,586 2 4
1905-06 ..	1,094 4 3	3,495 6 0	4,947 6 10	..	11,272 4 5	1,636 8 1	13,109 3 2
1906-07 ..	39 2 4	3,372 2 0	7,835 15 0	..	10,584 7 10	1,217 4 8	15,221 11 10
1907-08 ..	14 9 9	3,426 6 6	4,985 6 1	..	8,541 6 6	2,448 2 9	16,480 2 10
1908-09 ..	154 13 4	3,644 7 0	5,705 9 6	..	13,016 1 3	2,936 3 1	15,370 9 6
1909-10 ..	..	3,329 13 6	5,710 14 3	..	6,556 9 4	1,550 6 1	17,561 10 7
1910-11 ..	87 8 0	3,287 7 0	4,711 13 6	..	6,651 4 2	2,236 6 6	15,070 0 5
1911-12 ..	1,593 5 6	3,277 8 3	4,991 8 7	..	8,753 7 5	2,173 9 11	16,397 14 4
1912-13 ..	1,651 14 0	316 4 6	6,097 5 11	..	13,893 12 11	2,447 4 10	16,518 9 2
1913-14 ..	1,053 13 6	126 7 0	4,817 14 8	..	8,963 15 9	2,209 2 9	15,765 2 0
1914-15 ..	1,316 13 1	..	4,459 8 0	..	6,329 11 4	3,950 3 0	17,928 8 8
1915-16 ..	979 0 0	187 8 6	3,250 2 8	..	10,480 10 10	3,963 11 5	14,625 6 3
1916-17 ..	4,746 8 7	1,064 11 6	4,867 3 6	..	14,355 2 4	3,265 3 3	14,884 12 3
1917-18 ..	711 0 3	2,115 1 0	7,888 5 9	..	29,887 8 4	8,360 0 5	22,977 3 11
1918-19 ..	2,064 0 0	14,528 0 0		*4,484 0 0	52,830 0 0	23,373 0 0	28,837 0 0

* Expenditure in Mannarghat Range (Palghat Division) also included, as it is.
† Expenditure on fire protection is given separately from 1918-19 onwards.

200. *Summary of past expenditure*—cont.

Year.	Cost of works. Roads, etc. (9)	Cost of works. Buildings. (10)	Cost of works. Other works. (11)	Miscellaneous. (12)	Cost of establishment. Pay and allowance. (13)	Cost of establishment. Contingencies. (14)	Total. (15)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1840-41 ..	..	..	..	..	450 0 0	..	8,450 0 0
1841-42 ..	..	..	..	..	1,134 8 0	..	2,810 13 0
1842-43 ..	..	..	..	..	677 15 0	..	1,766 1 0
1843-44 ..	..	..	..	..	816 3 1	..	2,097 13 8
1844-45 ..	..	..	..	..	8[illegible]3 6 2	..	2,323 6 4
1845-46 ..	..	..	..	..	1,740 0 0	..	2,909 5 0
1846-47 ..	..	..	..	..	1,740 0 0	..	3,135 15 0
1847-48 ..	..	..	..	..	1,740 0 0	..	3,228 12 11
1848-49 ..	..	..	..	..	1,740 0 0	..	3,217 14 7
1849-50 ..	..	..	..	..	1,740 0 0	..	3,183 13 11
1850-51 ..	..	..	..	..	1,740 0 0	..	3,433 3 1
1851-52 ..	..	..	..	..	1,740 0 0	..	2,834 15 1
1852-53 ..	..	..	..	..	1,740 0 0	..	4,542 2 8
1853-54 ..	..	..	..	..	1,740 0 0	..	3,158 10 11
1854-55 ..	..	..	..	..	1,740 0 0	..	3,284 0 11
1855-56 ..	..	..	..	..	1,740 0 0	..	2,870 4 2
1856-57 ..	..	..	..	..	1,740 0 0	..	3,194 14 0
1857-58 ..	..	..	..	..	1,740 0 0	..	2,938 11 3
1858-59 ..	..	..	..	..	1,740 0 0	..	2,348 10 10
1859-60 ..	..	..	..	..	1,740 0 0	..	3,935 7 1
1860-61 ..	..	..	..	..	1,740 0 0	..	2,907 4 7
1861-62 ..	..	..	..	..	1,740 0 0	..	3,779 5 6
1862-63 ..	..	..	..	..	3,013 2 4	..	6,766 5 9
1863-64 ..	..	15 0 0	..	56 11 11	4,711 14 2	46 7 10	12,837 14 7
1864-65 ..	10 0 0	9 3 1	..	144 13 0	4,638 4 0	86 12 8	16,439 6 11
1865-66 ..	..	5 13 8	..	64 1 0	5,211 12 1	32 12 0	16,357 2 11
1866-67 ..	..	66 4 7	..	37 4 0	5,757 12 6	180 0 0	13,877 9 7
1867-68 ..	..	25 5 1	..	22 8 0	5,721 0 8	92 5 10	14,498 0 8
1868-69 ..	..	121 1 6	..	21 0 0	7,168 14 9	80 0 0	17,046 1 10
1869-70 ..	..	7 11 9	..	101 1 0	6,513 8 9	80 0 0	16,891 4 3
1870-71 ..	..	7 11 9	..	25 11 10	6,864 1 1	1 9 6	21,042 1 6
1871-72 ..	..	15 13 0	..	74 15 0	7,135 13 6	160 0 0	25,911 14 7
1872-73 ..	28 6 10	248 3 7	..	53 9 2	9,838 12 10	182 3 9	1,06,937 12 3
1873-74 ..	31 13 4	1,001 2 10	..	919 0 5	11,782 8 5	309 11 5	33,695 1 10
1874-75 ..	57 0 6	643 15 4	..	280 2 11	8,644 2 1	122 0 0	26,572 6 7
1875-76 ..	16 0 0	545 7 4	..	519 12 9	8,307 14 5	214 4 8	27,409 9 5
1876-77 ..	96 11 0	684 8 6	1 3 4	386 10 7	9,882 2 10	242 2 9	27,027 6 1
1877-78 ..	39 0 0	605 0 0	..	201 15 3	9,569 14 4	111 13 9	23,216 7 4
1878-79 ..	34 0 0	362 12 0	..	481 5 8	10,208 9 11	162 3 6	25,787 0 6
1879-80 ..	..	1,823 11 6	47 4 0	1,721 3 1	9,704 12 9	386 15 11	31,172 9 11
1880-81 ..	40 5 0	231 0 0	..	1,819 12 5	10,095 7 5	303 9 0	26,114 11 6
1881-82 ..	26 0 0	78 0 0	..	2,620 13 10	11,594 6 2	145 13 2	32,315 2 8
1882-83 ..	8 8 9	158 4 0	..	2,357 10 10	10,345 6 3	145 12 11	28,134 14 8
1883-84 ..	20 4 0	199 8 0	..	1,995 11 7	12,519 0 6	137 8 9	28,815 7 2
1884-85 ..	223 2 0	250 8 0	..	2,134 5 0	13,572 11 3	124 11 0	29,992 7 6
1885-86 ..	3 0 0	114 10 0	237 6 0	5,841 8 2	13,365 12 0	63 0 0	44,953 0 2
1886-87 ..	188 9 0	271 13 9	534 3 11	5,961 9 7	14,548 1 6	330 5 4	42,037 13 9
1887-88 ..	792 13 6	4,401 11 0	268 11 4	2,720 13 6	15,571 15 2	242 4 6	38,287 0 1
1888-89 ..	301 14 0	8,556 14 10	256 12 0	4,056 11 8	16,169 9 11	187 14 7	91,616 8 5
1889-90 ..	286 10 0	1,094 7 8	244 9 0	2,500 3 11	16,376 15 4	100 11 0	38,626 6 7
1890-91 ..	229 9 0	691 9 0	136 4 0	1,758 9 10	18,634 13 10	311 0 1	42,841 7 3
1891-92 ..	372 0 0	760 2 5	380 6 0	4,338 3 5	21,075 8 1	222 4 0	46,303 0 1
1892-93 ..	76 0 0	425 3 8	176 15 3	1,279 12 4	19,149 2 4	195 15 11	47,682 5 11
1893-94 ..	174 10 6	1,380 11 5	148 4 1	1,048 10 2	19,873 6 5	233 2 9	43,667 3 8
1894-95 ..	160 8 0	895 9 5	28 4 0	2,203 5 3	25,718 4 1	394 2 3	52,061 0 3
1895-96 ..	146 8 0	554 10 11	378 2 0	2,034 1 2	28,823 1 4	380 10 4	51,349 7 0
1896-97 ..	88 12 0	4,148 6 4	382 2 6	1,995 11 0	20,709 6 6	736 15 9	57,558 6 10
1897-98 ..	..	2,145 12 7	257 12 0	1,623 15 6	20,615 14 2	593 3 0	52,723 5 2
1898-99 ..	662 15 0	911 6 5	307 8 0	1,396 8 5	19,606 10 0	483 13 11	51,903 12 11
1899-00 ..	950 13 0	2,198 7 9	154 4 6	5,429 13 6	20,913 8 9	516 13 7	59,168 0 9
1900-01 ..	764 0 0	897 6 8	627 0 10	18,499 0 7	23,447 15 1	910 2 6	1,11,759 13 0
1901-02 ..	1,100 11 0	4,051 8 8	300 4 2	2,263 6 3	16,500 4 9	1,118 12 1	56,361 8 6
1902-03 ..	835 13 0	3,639 11 3	208 7 6	1,88[illegible] 1 6	13,833 12 1	1,443 15 11	54,293 14 0
1903-04 ..	1,746 4 10	1,222 7 2	301 0 1	2,738 8 5	12,803 10 8	1,214 7 10	48,313 7 7
1904-05 ..	718 12 0	3,480 8 4	1,4[illegible]3 4 2	3,102 10 9	17,865 2 10	1,015 11 2	64,455 5 5
1905-06 ..	1,153 12 11	1,226 7 8	984 1 4	6,451 7 10	14,097 2 0	768 5 9	60,236 6 3
1906-07 ..	787 0 0	500 1 7	1,225 4 10	4,705 1 7	12,262 2 7	662 7 1	58,412 13 4
1907-08 ..	834 11 6	1,702 5 10	283 10 0	4,060 10 11	16,119 0 2	663 13 6	59,560 6 4
1908-09 ..	921 8 0	1,373 7 0	492 1 6	2,396 7 9	22,061 0 7	795 0 2	68,867 4 8
1909-10 ..	792 14 3	1,050 7 9	962 13 2	3,853 11 1	17,970 0 1	2,367 8 3	61,706 12 4
1910-11 ..	918 2 1	2,505 7 8	501 11 5	3,318 15 6	21,825 6 9	1,133 1 8	62,247 4 8
1911-12 ..	2,416 7 2	4,338 13 6	970 3 2	2,694 5 10	23,559 5 0	713 7 9	71,880 0 5
1912-13 ..	3,131 0 8	1,949 2 3	299 15 1	2,366 0 3	25,882 6 2	976 3 7	75,523 15 4
1913-14 ..	3,470 3 1	4,590 2 3	1,209 8 2	3,274 7 0	22,257 10 3	857 2 10	68,595 9 3
1914-15 ..	2,471 10 6	4,676 3 4	785 8 2	4,603 15 5	22,999 6 3	1,165 15 10	70,687 7 7
1915-16 ..	1,770 15 6	2,743 0 1	654 15 6	5,483 2 5	25,400 11 6	1,566 6 1	71,805 10 9
1916-17 ..	1,720 4 10	3,671 14 6	784 8 6	2,890 15 0	31,089 14 9	947 1 2	84,288 12 2
1917-18 ..	3,167 2 11	2,443 14 8	405 5 3	4,284 8 0	28,410 11 1	1,888 3 5	1,12,539 1 0
1918-19 ..	3,879 0 0	1,183 0 0	2,379 0 0	*11,674 0 0	*36,566 0 0	*2,151 0 0	*1,86,948 0 0
1919-20 ..	6,613 0 0	6,887 0 0	2,992 0 0	*15,095 0 0	*38,349 0 0	*2,767 0 0	*2,49,539 0 0

impossible to get details owing to destruction of records in rebellion
It was probably included under tending and maintenance in previous years.

200. *Summary of past expenditure*—cont.

Year. (1)	Cost of acquisition and lease payments. (2)	Cost of conservancy and exploitation. Regeneration operations. (3)	Tending and maintenance. (4)	† Fire protection. (5)	Exploitation. Timber and saplings. (6)	Bamboos. (7)	Live-stock. (8)
	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1919-20 ..	1,511 0 0	19,210 0 0		*4,381 0 0	71,157 0 0	32,487 0 0	48,090 0 0
1920-21 ..	2,092 12 5	23,642 7 2		*4,591 14 7	96,492 3 3	32,493 4 9	64,700 15 3
1921-22 ..	1,500 0 0	13,983 4 9		2,821 15 0	22,726 12 6	18,936 9 7	26,914 5 9
1922-23 ..	1,500 0 0	15,872 5 5		3,552 9 9	41,178 13 11	17,865 6 10	36,152 11 5
1923-24 ..	39 3 0	18,499 9 4		4,023 11 3	53,377 10 2	10,057 3 3	35,449 2 11
1924-25 ..	8,651 5 11	10,967 10 5		3,370 14 0	73,112 5 9	15,551 11 10	42,010 5 2
1925-26 ..	1,998 10 5	24,910 7 3		3,238 3 9	1,41,347 10 10	24,507 9 7	38,538 11 2
1926-27 ..	1,981 12 5	34,836 1 6		4,135 8 6	1,42,510 1 7	19,488 6 8	39,544 4 6
	2,27,278 7 0	5,96,265 13 6		34 599 12 10	11,63,567 12 10	2,61,875 12 4	7,21,590 13 0

* Expenditure in Mannarghat Range (Palghat Division) also included, as it is impossible to get details owing to destruction of records in rebellion.

† Expenditure on fire protection is given separately from 1918-19 onwards. It was probably included under tending and maintenance in previous years.

Year.	Cost of works. Roads, etc. (9)	Buildings. (10)	Other works. (11)	Miscellaneous. (12)	Cost of establishment. Pay and allowances. (13)	Contingencies. (14)	Total. (15)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1920-21 ..	2,773 15 1	10,890 9 3	1,429 11 7	*18,141 2 1	*48,218 8 0	*2,862 8 9	*3,08,330 0 2
1921-22 ..	1,491 11 3	4,667 0 0	355 3 8	8,451 8 5	45,825 4 2	3,495 14 6	1,51,169 9 7
1922-23 ..	3,276 12 3	19,850 15 4	509 15 6	8,366 4 8	54,828 10 0	4,171 15 11	2,07,076 9 0
1923-24 ..	2,181 9 11	12,146 8 11	10 1 0	8,954 1 7	63,992 11 0	3,077 10 9	2,11,809 3 1
1924-25 ..	1,830 3 2	2,141 0 7	123 1 0	12,944 14 1	82,419 2 9	2,940 13 6	2,56,063 8 2
1925-26 ..	4,705 0 1	6,937 1 1	949 0 3	4,280 7 1	65,730 0 0	2,625 9 0	3,19,768 6 6
1926-27 ..	2,016 11 8	6,739 4 11	72 13 6	5,268 7 5	72,407 11 0	2,300 8 5	3,31,301 12 1
	62,505 2 4	1,53,163 4 11	25,190 9 3	2,35,267 2 1	13,89,288 12 2	54,942 10 10	49,25,536 1 1

* Expenditure in Mannarghat Range (Palghat Division) also included, as it is impossible to get details owing to destruction of records in rebellion.

201. "*Capital account.*—In that all the forests covered by this working plan to which the above data of revenue and expenditure refer, are either leased or have been purchased, the opportunity is taken to prepare a capital account of all receipts and charges. Attempts have been made, on previous occasions, to separate the receipts and charges relating to the teak plantations from those relating to the natural forests. The summaries now prepared show that this is not possible without resorting to apportionment on a purely arbitrary basis. Moreover, the teak plantations are being extended and a capital account, prepared for them in any one year, would need complete revision year by year, or, at least, period by period. A general account for all the forests dealt with in this plan has therefore been prepared."—*R. Bourne*

The account shows that, calculating at 3½ per cent compound interest, the profit to the end of 1926-27 had amounted to Rs. 23,29,716.

Money Capital Account.

Year	Revenue in the year.	Sum of revenue with compound interest to date p = 3½ per cent	Expenditure in the year.	Sum of expenditure with compound interest to date p = 3½ per cent.	Profit to date.
	RS. A. P.	RS.	RS. A P.	RS.	RS.
1840-41	..	..	8,450 0 0	8,450	..
1841-42	..	..	2,810 13 0	11,557	..
1842-43	475 7 8	475	1,766 1 0	13,727	..
1843-44		492	2,097 13 8	16,305	..
1844-45	12 14 0	522	2,323 6 4	19,199	..
1845-46	..	540	2,909 5 0	22,780	..
1846-47	..	559	3,135 15 0	26,713	..
1847-48	..	579	3,228 12 11	30,877	..
1848-49	767 1 8	1,366	3,217 14 7	35,176	..

Money Capital Account—*cont.*

Year.	Revenue in the year.	Sum of Revenue with compound interest to date p = $3\frac{1}{2}$ per cent.	Expenditure in the year.	Sum of expenditure with compound interest to date p = $3\frac{1}{2}$ per cent.	Profit to date.
	RS. A. P.	RS.	RS. A. P.	RS.	RS.
1849-50	427 0 0	1,841	3,183 13 11	39,591	..
1850-51	444 8 5	2,350	3,438 3 1	44,415	..
1851-52	819 2 6	3,251	2,834 15 1	48,805	..
1852-53	4,785 12 9	8,150	4,542 2 8	55,055	..
1853-54	687 0 5	9,122	3,158 10 11	60,141	..
1854-55	503 0 2	9,944	3,284 0 11	65,530	..
1855-56	299 8 5	10,592	2,870 4 2	70,694	..
1856-57	257 8 0	11,220	3,194 14 0	76,363	..
1857-58	854 3 1	12,467	2,938 11 3	81,975	..
1858-59	1,768 13 6	14,672	2,348 10 10	87,193	..
1859-60	5,717 2 9	20,903	3,935 7 1	94,180	..
1860-61	4,615 6 3	26,250	2,907 4 7	1,00,383	..
1861-62	808 0 0	27,977	3,779 5 6	1,07,675	..
1862-63	17,722 14 10	46,679	6,766 5 9	1,18,210	..
1863-64	7,641 2 2	55,054	12,837 14 7	1,35,185	..
1864-65	27,158 11 10	85,071	16,439 6 11	1,56,355	..
1865-66	14,621 7 11	1,02,669	16,357 2 11	1,78,184	..
1866-67	27,006 5 7	1,33,268	13,877 9 7	1,98,298	..
1867-68	3,097 0 0	1,41,029	14,498 0 8	2,19,736	..
1868-69	15,006 5 9	1,61,871	17,046 1 10	2,44,473	..
1869-70	10,454 5 10	1,77,990	16,891 4 3	2,69,921	..
1870-71	16,050 0 0	2,00,270	21,042 1 6	3,00,410	..
1871-72	8,508 12 6	2,15,788	25,911 14 7	3,36,836	..
1872-73	17,145 10 1	2,40,487	1,06,937 12 3	4,55,563	..
1873-74	24,312 7 6	2,73,216	33,695 1 10	5,05,203	..
1874-75	14,430 15 2	2,97,210	26,572 6 7	5,49,457	..
1875-76	19,889 10 10	3,27,502	27,409 9 5	5,96,098	..
1876-77	33,031 3 2	3,71,996	27,027 6 1	6,43,988	..
1877-78	22,515 2 5	4,07,531	23,216 7 4	6,89,744	..
1878-79	34,205 2 9	4,56,000	25,787 0 6	7,39,672	..
1879-80	24,884 10 0	4,96,845	31,172 9 11	7,96,734	..
1880-81	64,161 5 9	5,78,396	26,114 11 6	8,50,735	..
1881-82	49,745 10 1	6,48,386	32,315 2 8	9,12,826	..
1882-83	32,739 6 6	7,03,819	28,134 14 8	9,72,910	..
1883-84	55,093 15 1	7,83,547	28,815 7 2	10,35,777	..
1884-85	2 0 0	8,10,973	29,992 7 6	11,02,021	..
1885-86	81,137 11 5	9,20,495	44,953 0 2	11,85,545	..
1886-87	17,720 6 1	9,70,432	42,037 13 9	12,69,077	..
1887-88	42,385 10 7	10,46,783	38,287 0 1	13 51,782	..
1888-89	41,467 15 3	11,24,888	91,616 8 5	14,90,711	..
1889-90	38,100 0 3	12,02,359	38,626 6 7	15,81,512	..
1890-91	44,7[illegible]6 1 7	12,89,217	42,841 7 3	16,79,706	..
1891-92	42,768 11 6	13,77,109	46,303 0 1	17,84,799	..
1892-93	42,428 1 5	14,67,736	47,682 5 11	18,94,949	..
1893-94	72 712 7 10	15,91,819	43,667 3 3	20,04,939	..
1894-95	62,520 12 1	17,10,054	52,061 0 3	21,27,173	..
1895-96	37,243 10 7	18,07,150	51,349 7 0	22,52,973	..
1896-97	80,406 8 10	19,50,807	57,558 6 10	23,89,385	..
1897-98	96,015 12 6	21,15,101	52,723 5 2	25,25,736	..
1898-99	60,705 9 0	22,49,836	51,903 12 11	26,66,041	..
1899-00	76,936 11 7	24,05,517	59,168 0 9	28,18,520	..
1900- 1	2,28,666 5 7	27,18.376	1,11,759 13 0	30.28,928	..
1901-02	87,257 4 1	29,00,776	56,361 8 6	31,91,302	..
1902-03	60,744 13 4	30,63,048	54,293 14 0	33,57,292	..
1903-04	51,432 13 4	32,21,688	48,313 7 7	35,23,110	..
1904-05	67,416 15 0	34,01,864	64,455 5 5	37,10,874	..
1905-06	58,686 11 4	35,79,616	60,236 6 3	39,60,991	..
1906-07	1,47,905 6 4	38.52,808	58.412 13 4	40,95,939	..
1907-08	94,716 12 1	40,84,373	59,560 6 4	42,98,857	..
1908-09	1,40,247 6 2	43,65,503	68,867 4 8	45,18,184	..
1909-10	1,48,292 13 9	46,66,589	61,706 12 4	47,38,027	..
1910-11	92,762 8 8	49,22,683	62,247 4 8	49,66,105	..
1911-12	1 14,339 10 5	52,09,317	71,880 0 5	52,11,799	..
1912-13	1,41,347 0 2	55,32,990	75,523 15 4	54,69,736	63,254
1913-14	94,820 12 4	58,21,466	68,595 9 3	57,29,773	91,693
1914-15	1,27,338 2 6	61,52,555	70,687 7 7	60,01,002	1,51,553
1915-16	1,49,644 3 8	65,17,538	71,805 10 9	62,82,843	2,34,695
1916-17	1,69,867 13 5	69,15,520	84,288 12 2	65,87,032	3,28,488
1917-18	4,32,835 13 0	75,90,389	1,12,539 1 0	69,30,117	6,60,272
1918-19	4,07,309 2 0	82,63,362	1,86,948 0 0	73,59,619	9,03,743
1919-20	6,95,473 12 3	92,48,054	2,49,539 0 0	78,66,745	13,81,309
1920-21	4,89,881 14 8	1,00,61,618	3,08,330 0 2	84,50,411	16,11,207
1921-22	1,82,498 15 6	1,05,96,274	1,51,169 9 7	88,97,345	16,98,929
1922-23	2,26,011 11 1	1,11,93,156	2,07,076 9 0	94,15,829	17,77,327
1923-24	2 63,682 2 6	1,18,48,598	2,11,809 3 1	99,57,192	18,91,406
1924-25	3,01,515 13 0	1,25,64,816	2,56,063 8 2	1,05,61,758	20,03,057
1925-26	4,14,162 2 1	1,34,18,746	3,19,768 6 6	1,12,51,188	21,67,558
1926-27	4,17,596 3 0	1,43,05,998	3,31,301 12 1	1,19,76,282	23,29,716

CHAPTER VI—STATISTICS OF GROWTH AND YIELD.

SECTION 1—STATISTICS RELATING TO TEAK.

202. *Mr. Bourne's yield tables.*—Provisional yield tables for teak were prepared by Mr. Bourne, and have been published in a small book. His tables are based on the simultaneous measurement of a large number of sample plots of different ages and of all qualities of growth. His own description of the methods adopted has been printed in a separate publication, so there is no need to go into the subject here. Three qualities have been distinguished, and the tables contain for every age from 1 to 80 years, and for one acre of each of the three qualities, the following information :—Number of stems, basal area, average girth of dominant trees, average height of dominant trees, stemwood and crownwood volume with form factors, intermediate yields, final yield, total yield, mean annual volume increment and current annual volume increment. His money yield tables for the three qualities, and for all ages from 5 to 80 years, show the gross and nett values, per cubic foot and per acre, of the major and intermediate yields, separately for the two Ranges. Tables of stemwood volume and form factors, for single teak trees, have also been prepared. A comparison of actual final yields in the past ten years, with the yield table estimates, show that the latter are, on the whole, very reasonably accurate. In fact they are often remarkably accurate. In the case of thinnings, large differences between estimates and actuals have been usual, but it is impossible to criticize the yield tables on this account, for in thinnings the personal factor is bound to influence the yield to a very great extent. Finally, in future comparisons of actuals with yield table estimates, it is necessary to remember one very important point. The yield tables are prepared for fully stocked woods. In order to use them, the density of each sub-compartment has to be estimated, and this estimation is by no means easy. An error of one decimal point is easy to make, and such an error means a difference of ten per cent in the yield from every unit of area to which the incorrect density is applied. The money yield tables were based on prices which have not been maintained, and the costs of extraction used in the calculations are less than the present costs. In these circumstances they cannot be applied as they stand, and the present writer has not thought fit to revise them since the timber market is still far from stable, and since it is hoped that the cost of extraction will soon be reduced.

203. *Statistics from periodical measurements of sample plots.*—To provide for the subsequent revision of his provisional yield tables, Mr. Bourne laid out 41 permanent sample plots, in fully stocked woods ; and measured them in 1918. They were remeasured in 1923 and are again being measured at the time of writing. There are, also, eight permanent sample plots laid out by the Forest Research Institute, Dehra Dun (all in young plantations) and these, too, are now being measured for the third time. In 1928, four new plots were laid out in second rotation plantations, by the Forest Research Officer, and are being measured. It is proposed to discard about 17 of Mr. Bourne's plots, and two of the Dehra Dun plots, chiefly on account of deficiency in stocking, but the question awaits decision. The object of all the plots is to study volume increment. The upkeep and measurement of the plots are entrusted to the Forest Research Officer, and the calculations are undertaken in the Forest Research Institute, Dehra Dun, where yield tables will ultimately be compiled.

SECTION 2—STATISTICS RELATING TO SPECIES OTHER THAN TEAK.

204. *Timber species.*—There has been no opportunity, in the past, to collect statistics of the rates of growth of miscellaneous species, since there are practically no woods of known ages. The occurrence of these species in the teak plantations affords an opportunity of comparing their rates of growth with that of the teak, since, with a few exceptions, it is certain that they are at least not older than the teak. In good teak localities there is no timber species which grows faster (from the seedling stage) than teak, in the first two years. From the third to the fourth year,

Tetrameles nudiflora Bombax malabaricum Lagerstroemia microcarpa and *Terminalia tomentosa* catch up teak. By the tenth year so, also, does *Terminalia paniculata.* Rosewood grows much more slowly than teak in early years, but there is little doubt that it will eventually outstrip the teak, except in the best teak localities. *Xylia xylocarpa* is the only common representative of the valuable deciduous species which will continue to keep below the crowns of teak of equal age, in all teak localities except the poorest. Though there are no figures (or very meagre figures) to prove it, it seems probable that in suitable localities (though not necessarily the best localities available) a rotation of about sixty years would give crops of *Terminalia tomentosa*, *Terminalia paniculata* and *Lagerstroemia microcarpa*, averaging 5 feet to 6 feet in girth. Five volume increment sample plots have been laid out, in recent years, in pure woods of miscellaneous species, and are measured every five years, as follows:—

(*a*) *Xylia xylocarpa* two plots, in areas on which teak was planted in 1889, and subsequently failed. The age of the *Xylia* is not known, but it probably originated a few years later than 1889.

(*b*) *Lagerstroemia microcarpa*, one plot, in a small plantation of this species formed in 1919.

(*c*) *Lagerstroemia-Flos-Reginae*, two plots. One is in a middle-aged crop (of unknown age) in the 1854 teak plantation. The second is in a small plantation of this species formed in 1919.

In addition to the above, there is one diameter increment sample plot in a patch of pure *Hopea parviflora* of all stages from seedlings to poles of about 6 inches diameter. Numerous periodical girth measurements of individual trees of *Swietenia macrophylla* have been taken in past years. It appears that this species attains a girth of 5 feet to 10 feet, in 35 years, in the poorest teak localities.

205. *Bamboos.*—Mr. Bourne collected certain statistics about the rate of growth of *Bambusa arundinacea.* No subsequent investigation has been undertaken, so his experience may be quoted:—" Early in 1914, as the result of the visit of a member of the firm of Messrs. Thomas Nelson & Sons, Publishers, Edinburgh, a report was drawn up on the possibility of supplying annually 20,000 tons of air dry bamboos for the manufacture of paper pulp. Certain data on which the report was based may be quoted. In the first place, the bamboo in the division commenced to flower sporadically in 1911, and the following records of past flowering are of importance. It is reported to have flowered gregariously in 1804, 1836 and 1866 (Brandis' Indian Trees, page 671) and sporadically, particularly along the river banks, in 1881. In recent years it has flowered in Edacode in 1911, in Chatomborai in 1911 and 1912, in New Amarampalam, Nellicutta and Karumpoya from 1912, up to the present time and in Pokode and Kanakuth in 1918. It has hardly flowered in Pannengode, very little in Walluvasseri and very little along the banks of the main river. In 1914, new clumps had already formed as a result of the flowering in Edacode in 1911. There were, however, rarely more than one or two culms to each clump, and moreover such culms were not full-sized. By 1918, there were about 6 or 7 culms per clump both in Edacode and Chatomborai. One or two of these culms were fullsized. In the year after flowering, no culm is formed, nor have the seedlings combined into clumps. In the second year the clumps are recognizable and a very small culm is produced. From then on to the seventh or eighth year it would appear that a new culm is produced each year, though such culms are not fullsized until these years. In older clumps enumeration in 1914 showed that on the average one new culm was annually produced for every four old culms in the clump. From above the ninth to the tenth year it is to be expected that clumps will produce two new culms annually, making at the end of the tenth year about eleven culms in all. If three annually are produced in the eleventh and twelfth years and four in the fourteenth year, the clumps may be considered to be in full bearing at the end of the latter year, with about 21 culms. If four culms per clump are then annually felled, they should certainly be replaced by four new culms in the following monsoon. These approximate calculations assume that no cutting takes

place until after the growth of the thirteenth year. The following statement should make this clearer :—

Number of years after flowering.	New culms produced.	Number of old culms already in the clumps.	Number of culms at the end of the year.	Number of culms cut.	Yield per acre assuming 30 to 40 clumps per acre.
1	..	..	..	..	..
2	1 small	..	1	..	..
3	1 ,,	1	2	..	..
4	1 ,,	2	3	.	..
5	1 ,,	3	4	..	..
6	1 ,,	4	5	..	..
7	1 large	5	6	..	..
8	1 ,,	6	7	..	..
9	2 ,,	7	9	..	..
10	2 ,,	9	11	..	..
11	3 ,,	11	14	..	..
12	3 ,,	14	17	..	..
13	4 ,,	17	21	4	120—160
14	4 ,,	17	21	4	120—160

An enumeration, carried out in 1914, of the number of culms per clump in an area which had recently and annually been heavily cut over, showed an average of 11·85 culms. These might be expected to put on three culms in the next year. If, therefore, twelve culms on the average were always left, the annual yield would be three culms per clump, or 90 to 120 culms per acre. Instead of commencing at the end of the thirteenth year it might be first expected after the tenth or eleventh years. All the above calculations are, of course, entirely provisional." [R. Bourne]

CHAPTER VII.—ESTIMATE OF COST VALUE OF THE LAND.

206. *General.*—Since all the forests covered by this working-plan are either leased or have been purchased, it is of some interest to determine their approximate cost value.

207. *Statements of kuttikanam and lease payments.*—From 1916–17 onwards, the system of a fixed annual rental, instead of the old kuttikanam payments was adopted in respect of the lease with the Trickalayur Devaswam. From 1924–25 onwards, the same system was adopted in respect of the lease with the Zamorin of Calicut. Two statements must therefore be given, one for kuttikanam and the other for lease payments. (Mr. Bourne's working-plan is taken as the authority for figures up to the year 1917–18.)

Statement of kuttikanam due and paid to Urlan Trickalayur Devaswam.

Statement of kuttikanam due and paid to

Year in which due.	Year in which paid or recovered.	Mortgage or renewal fee janmabhogam.	Advances recoverable and recovered.	On 17,400 teak blackwood, etc., trees at Re. 1.		On teak and blackwood saplings at As. 8.		On planted teak 9" and over ¼ girth at As. 8.		On Bam Departmental Agency.	
				Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.
		RS. A.	RS. A.		RS. A.		RS. A.		RS. A.		RS. A. P.
..	1840-41 ..	1,000 0	7,000 0	..	..	..	..	..	..	..	..
1842-43 ..	1842-43 ..	..	..	..	..	..	..	..	..	..	..
1852-53 ..	1852-53 ..	..	(a) 326 0	326	326 0	..	..	..	..	..	..
1853-54 ..	1853-54 ..	..	(a) 127 0	127	127 0	..	..	..	..	..	..
1854-55 ..	1854-55 ..	..	(a) 127 0	127	127 0	..	..	..	..	..	..
1857-58 ..	1857-58 ..	..	..	..	..	..	..	..	..	..	..
1859-60 ..	1859-60 ..	..	..	..	..	..	..	..	..	..	..
1861-62 ..	..	..	..	..	..	..	..	..	..	..	..
1862-63 ..	..	..	..	178	178 0	..	..	..	..	..	..
1863-64 ..	..	..	..	350	350 0	..	..	..	..	15,200	334 2 10
1864-65 ..	..	..	..	179	179 0	..	..	..	..	5,300	183 10 11
1865-66 ..	..	..	..	7	7 0	..	..	..	..	5,190	185 12 4
1866-67 ..	..	..	..	373	373 0	..	..	..	..	6,869	209 2 11
1867-68 ..	..	..	..	..	..	..	..	..	..	..	..
1868-69 ..	1869-70 ..	..	1,240 0	153	153 0	..	..	..	..	1,522	43 0 7
1869-70 ..	..	..	..	224	224 0	..	..	..	..	2,766	38 8 9
1870-71 ..	1871-72 ..	200 0	..	2	2 0	..	..	..	..	200	(g) 1 9 2
1872-73 ..	1873-74 ..	..	245 0	19	19 0	..	..	..	..	14,094	(g) 88 10 1
1873-74 to 1877-78	1878-79 ..	..	429 0	858	(d) 858 0	..	..	..	..	..	..
1877-78 and 1878-79	1879-80 ..	..	235 8	471	(d) 471 0	..	..	..	..	9,793	7 1 11½
1878-79 ..	1880-81 ..	..	48 0	97	(e) 97 0	..	..	..	..	9,157	66 10 7
..	1881-82 ..	..	..	..	..	..	..	..	..	..	..
1880-81 and 1881-82	1882-83 ..	..	1,234 8	2,469	(d) 2,469 0	..	..	..	..	40,370	351 5 4
1881-82 ..	..	..	..	369	(d) 369 0	..	..	..	..	..	..
1882-83 ..	1883-84 ..	..	184 0	..	..	..	..	..	..	22,876	490 6 0
1883-84 ..	..	..	..	..	..	..	..	..	..	9,604	183 9 4
1884-85 ..	1885-86 ..	..	..	..	..	..	..	..	..	6,850	39 8 1
1885-86 ..	1886-87 ..	..	..	..	..	..	..	10	5 0	10,201	155 2 7
1886-87 ..	1887-88 ..	..	..	20	(h) 20 0	..	..	35	17 8	11,087	228 6 1
1885-86 to 1887-88	1888-89 ..	..	212 12	121	(d) 121 0	599	(i) 299 8	10	(i) 5 0	3,874	26 11 10
1888-89 ..	1899-90 ..	..	67 4	120	(d) 120 0	2	(i) 1 0	27	(i) 13 8	7,100	198 15 2
1888-90 ..	1890-91 ..	..	76 12	135	(d) 135 0	..	..	37	(i) 18 8	5,890	128 11 0
1890-91 ..	1891-92 ..	..	9 0	13	(d) 13 0	..	..	10	(i) 5 0	10,401	244 9 4
1891-92 ..	1892-93 ..	..	10 8	13	(d) 13 0	..	..	16	(i) 8 0	3,929	42 15 7
1892-93 ..	1893-94 ..	..	23 8	291	(j) 291 0	..	..	28	(i) 14 0	2,260	38 7 5
1893-94 ..	1894-95 ..	..	38 0	185	(k) 185 0	..	..	27	13 8	6,550	87 2 7
1894-95 ..	1895-96 ..	..	405 0	..	..	..	..	172	86 0	7,375	142 5 0
1895-96 ..	1896-97 ..	..	..	..	..	8	4 0	13	6 8	2,031	20 2 2
1896-97 ..	1897-98 ..	..	..	..	..	..	..	79	39 8	..	..
1897-98 ..	1898-99 ..	..	..	..	..	..	..	374	187 0	325	(m) 204 4 0 (n) 4 12 5
1898-99 ..	..	..	..	..	..	..	..	39	19 8	699	(n) 10 4 4
1899-00 ..	1900-01 ..	..	4 0	4	4 0	..	..	190	95 0	625	(n) 9 5 8
1900-01 ..	1901-02 ..	..	6 0	6	6 0	..	..	19	9 8	547	8 0 10
1901-02 ..	1902-03 ..	200 0	36 0	36	36 0	10	5 0	30	15 0	650	9 12 0
1902-03 ..	1903-04 ..	..	..	3	(g) 3 0	..	..	202	101 0	970	10 11 4
1903-04 ..	1904-05 ..	..	3 0	..	..	..	..	127	63 8	..	..
1904-05 ..	1905-06 ..	..	..	..	..	..	..	406	203 0	..	..
1904-05 and 1905-06	..	..	..	30	30 0	..	..	328	164 0	..	..
1906-07 ..	..	..	..	..	..	..	..	183	91 8	22,216	121 7 10
1907-08 ..	..	..	..	..	..	..	..	230	115 0	33,932	394 15 9
1908-09 ..	1911-12 ..	..	..	..	..	..	..	579	289 8	50,145	142 5 5
1909-10 ..	..	..	..	..	..	..	..	528	264 0	52,551	478 15 8
1910-11 ..	1912-13 ..	..	..	5	5 0	..	..	241	120 8	42,174	397 9 0
1911-12 ..	1913-14 ..	..	..	..	..	..	..	509	254 8	37,300	431 4 6
1912-13 ..	1914-15 ..	..	..	..	..	..	..	200	100 0	50,251	1,007 8 8
1913-14 ..	1915-16 ..	..	..	1	1 0	..	..	658	329 0	19,700	344 5 6
1914-15 ..	..	..	..	..	..	..	..	..	..	..	..
1915-16 ..	1916-17 ..	..	..	..	..	..	..	..	..	..	..
Grand total ..		1,400 0	7,000 0	7,312	7,312 0	619	309 8	5,307	2,653 8	518,280	6,817 15 6½
.. ..	.. ..	.. ..	(a) 580 0 4,544 4	Paid .. Recovered.	2,370 0 4,942 0	Paid .. Recovered.	159 4 (i) 150 4	Paid .. Recovered.	2,621 8 (i) 32 0	14,294 ..	(g) 90 3 3 (m) 204 4 0
..	..	..	..	..	..	..	..	..	..	Paid ..	7,112 6 9½

This lease was terminated on 31st March 1916 and new lease, on the basis of the payment of a fixed

Reference.—(a) These amounts have not been shown in previous accounts as recovered—vide recovered of expenditure and revenue 1840-41 to 1861-62.

(b) These amounts have not been shown in previous accounts under the respective years paid—vide recovered of expenditure and revenue 1840-41 to 1861-62.

(c) These amounts represent loss incurred by Government by extraction of Junglewood and have been wrongly deducted from kuttikanam due under other heads—vide registers of kuttikanam due and paid to janmis.

(d) Moiety of kuttikanam that shoud have been recovered has been paid—vide registers of kuttikanam due and paid to janmis and R. Dis. 55/08.

(e) Moity of kuttikanam on 96 trees plus Re. 1 full kuttikanam on one tree that should have been recovered has been paid —vide registers of kuttikanam due and paid to janmis and R. Dis. 55/08.

(f) Rupees 1,000 advance payment of kuttikanam due in 1880-81 and 1881-82 and recovered in full in 1882-83—vide registers of kuttikanam due and paid to janmis.

(g) These bamboos are shown as felled from new clearing site for formation of plantation—vide registers of kuttikanam due and paid to janmis.

(h) Rupees 20 that should have been recovered has been paid—vide registers of kuttikanam due and paid to janmis and R. Dis. 55/08.

(i) Out of kuttikanam due on natural and planted saplings, which should have been paid, a moiety has been recovered —vide registers of kuttikanam due and paid to janmis and R. Dis. 55/08.

Urlan Trickalayur Devaswam.

boos.		On junglewood.									
By purchasers.		Departmental agency.				By purchasers.				Total annual or periodical kuttikanam due to be paid.	Total amount paid.
		New clearing 20 per cent.		General 50 per cent.		New clearing 20 per cent.		General 50 per cent.			
Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.		
	RS. A. P.		RS. A. P.		RS. A. P.		RS. A. P.		RS. A. P.	RS. A. P.	RS. A. P.
..	..	..	..	..	..	..	..	..	..	..	8,000 0 0
..	..	..	..	..	..	..	..	..	..	98 0 0	(b) 98 0 0
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	..	..	..	..	..	..	114 12 0	(b) 114 12 0
..	..	..	..	..	..	..	..	..	..	323 6 4	(b) 323 6 4
4,550	45 8 0	..	..	..	..	..	..	70	175 0 0	220 8 4	..
7,300	73 0 0	..	..	..	..	..	..	100	212 8 0	285 8 0	..
..	..	12	3 1 6	..	..	..	..	..	..	337 4 4	..
..	..	791	287 2 0	188	312 8 2	..	..	..	..	783 5 1	..
..	..	494	366 14 0	..	175 6 11	..	..	..	..	728 1 3	..
..	..	..	..	461	(c) 107 15 8	..	..	..	..	101 3 3	..
..	..	369	49 12 4	2	0 12 10	..	..	..	..	50 9 2	..
..	..	..	..	251	(c) 42 8 10	..	..	..	..	0 7 9	2,506 14 10
..	..	..	..	..	..	..	..	..	..	38 8 9	..
..	..	..	36 10 0	..	..	..	..	..	..	38 3 2	200 0 0
..	..	..	..	..	261 2 9	..	..	..	..	349 12 10	426 8 9
..	..	..	..	..	..	..	..	..	..	..	429 0 0
..	..	..	..	9	3 4 1½	..	..	..	..	10 6 1	245 14 1
..	..	..	..	1	5 3 5	..	..	..	..	71 14 0	120 14 0
..	..	..	..	..	..	..	..	..	..	..	(f) 1,000 0 0
..	..	..	..	1,971	1,334 12 3	..	..	..	..	1,686 1 7	(f) 1,920 9 7
..	..	..	..	859	502 13 3	..	..	..	..	502 13 3	..
..	..	..	..	..	..	..	..	..	..	490 6 0	1,177 11 8
..	..	..	..	..	..	..	..	..	..	183 9 4	..
..	..	..	..	..	..	..	..	..	..	39 8 1	223 1 5
..	..	..	..	..	..	..	..	..	..	160 2 7	160 2 7
1,605	24 1 2	..	..	..	..	..	..	263	241 8 3	511 7 6	531 7 6
2,000	30 0 0	..	..	..	..	406	40 9 7	..	28 0 1	429 13 6	338 1 6
3,625	54 6 0	..	..	..	..	..	..	3	8 10 9	276 7 11	329 3 11
10,340	153 0 0	..	..	..	..	..	..	207	115 5 4	415 8 4	473 12 4
8,609	116 12 2	..	..	..	..	..	..	138	77 13 2	444 2 8	448 2 8
14,340	167 1 7	..	..	218	258 11 6	1,188	187 11 7	167	118 4 11	782 13 2	785 5 2
25,192	316 15 11	767	106 11 5	351	(l) 1,508 13 10	1,933	229 15 7	68	30 2 9	2,245 2 11	745 13 1
13,165	197 7 7	210	302 4 9	497	(l) 1,337 14 7	..	..	557	405 4 0	2,343 9 6	1,005 10 11
10,812	162 3 0	..	..	..	..	675	175 0 0	78	54 12 0	620 4 0	3,467 0 5
9,500	142 8 0	..	..	..	..	..	..	241	260 11 8	433 13 10	433 13 10
8,725	130 2 0	..	..	..	..	..	..	319	386 11 8	556 5 8	556 5 8
3,650	53 10 0	..	..	31	(n) 80 11 11	..	..	96	250 0 9	780 7 1	490 10 9
..	..	..	..	21	(n) 15 12 0	..	..	8	(n) 6 0 0	51 8 4	..
6,025	90 3 0	..	..	{ 36 19	(n) 47 14 0 (o) 56 9 5 }	..	..	538	715 7 1	1,014 7 2	900 10 1
2,075	30 9 0	..	..	{ 841 25	(p) 763 9 11 38 11 4 }	..	..	980	1,517 6 11	(p) 2,367 14 0	..
12,050	180 12 0	..	..	..	..	..	..	1,347	2,350 9 10	2,561 1 10	4,763 14 3
8,330	91 15 3	..	..	17	30 2 11	..	..	619	1,181 0 2	(q) 1,414 13 8	763 9 11
56,700	566 8 0	..	..	..	512 13 0	..	..	1,341	2,480 15 9	(r) 3,623 12 9	4,471 7 1
15,550	155 8 0	..	..	..	..	..	..	..	25 0 0	383 8 0	1,007 4 9
4,750	46 4 0	..	..	830	13 14 3	..	..	..	..	224 2 3	..
4,400	61 0 0	..	..	..	..	..	..	..	..	273 15 10	..
2,013	25 3 2	..	..	52	39 1 6	..	..	..	..	574 4 5	..
3,750	41 4 0	..	..	85	47 13 7	..	..	..	..	520 15 0	1,593 5 6
11,200	151 0 0	..	..	5	0 12 0	..	..	28	6 0 0	900 11 8	..
5,850	76 12 0	..	..	8	6 0 0	..	..	..	..	600 13 8	1,501 8 11
3,075	55 14 0	..	..	28	50 7 9	..	..	4	8 0 0	800 2 3	800 2 3
1,475	24 6 0	..	..	8	12 0 0	..	..	4	3 1 0	1,146 15 8	1,146 15 8
5,786	103 1 6	..	..	7	10 0 0	..	..	13	25 14 6	812 5 6	812 5 6
..	..	..	..	..	..	..	..	..	..	(s) 1,500 0 0	..
..	..	..	..	..	..	..	..	..	..	(s) 1,500 0 0	3,000 0 0
266,442	3,366 15 4	..	1,152 8 0	..	7,427 13 2½	4,202	633 4 9	..	10,684 4 7	36,189 12 2	46,777 3 2
..	..	..	..	..	(c) 150 8 6	..	..	..	..	536 2 4	536 2 4
..	..	..	..	..	..	..	..	..	..	..	..
..	..	..	..	Paid ..	7,277 4 8½	..	..	..	..	36,725 14 6	47,313 10 6

annual rental, was entered into from 1st April of that year. This account is therefore closed.

(j) Out of Rs. 291 that should have been recovered, a moiety only on 33 trees has been recovered and the balance Rs. 16-8-0 paid, Rs. 258 was recovered in 1895-96—vide registers of kuttikanam due and paid to janmis and R. Dis. 55/08.

(k) Out of Rs. 185, Rs. 147 was only recovered in 1895-96—vide registers of kuttikanam due and paid to janmis and R. Dis. 55/08.

(l) Rupees 1,508-13-10 and Rs. 1,337-14-7 due from 1892-93 and 1893-94 respectively were only paid in 1895-96—vide registers of kuttikanam due and paid to janmis.

(m) Rupees 204-4-0 is kuttikanam due on minor produce collected departmentally and paid in 1902-03—vide R. Dis. 445/02.

(n) These amounts of kuttikanam were only paid in 1902-03—vide R. Dis. 445/02.

(o) Rupees 56-9-5 was paid in 1904-05—vide R. Dis. 18/04.

(p) Rupees 763-9-11 was paid in 1903-04 and the balance out of Rs. 2,367-14-0, i.e., Rs. 1,604-4-1 in 1902-03—vide R. Dis. 3/04 and R. Dis. 445/02.

(q) Rupees 1,414-13-8 was paid and Rs 3 recovered in 1904-05—vide R. Dis. 18/04.

(r) Out of Rs. 3,623-12-9 due in 1903-04, Rs. 1,000 was paid in advance in 1904-05 and the balance in 1905-06—vide R. Dis. 18/04 and R. Dis. 163/06.

(s) Kuttikanam for 1914-15 and 1915-16 was compounded—vide R. Dis. 13/04 and R. Dis 163/06.

Periodical amounts of kuttikanam which fell due between the years 1894–95 and 1913–14, and disputed by the Uralan of Trickalayur Devaswam and Thacharakavil Tirumalpad, were paid to the Uralan in 1916–17, on his executing an indemnity bond.

The amount paid was Rs. 1,746-8-7.

Statement of kuttikanam due and paid

Year in which due.	Year. in which paid.	Mortgage or renewal fee.	Advances recoverable.	On teak and blackwood, etc., trees at Re. 1.		On teak and blackwood saplings, etc., at As. 8.		On planted teak 9″ and over ¼ girth at As. 8.		On Departmental agency.	
				Number.	Kuttikanam.	Number.	Kuttikanam	Number.	Kuttikanam.	Number.	Kuttikanam.
											RS. A. P.
1862-63 ..	..	..	..	..	..	..	..	..	..	..	..
1863-64 ..	..	..	..	..	..	..	..	..	..	1,000	21 15 7
1865-66 ..	1870-71.	..	..	..	..	..	..	..	..	1,500	53 12 0
1873-74 to 1877-78 ..	1878-79.	..	..	..	..	..	..	..	..	3,860	33 9 11
1914-15 and 1915-16 ..	1917-18.	..	..	..	..	..	..	..	..	76	1 5 0
1916-17 ..	..	..	..	..	..	..	..	..	..	75	1 4 8
1923-24 ..	1924-25.	..	..	..	..	..	..	..	..	40	0 8 0
1918-19 to 1922-23 ..	1927-28.	..	..	..	..	..	..	..	..	345,944	6,387 0 0
Total ..		..	..	..	..	..	..	..	..	352,495	6,499 7 2

Reference.—(*a*) These amounts, or portions thereof, are to be recovered by Government, if the Tirumalpad is unable to substantiate his claim.
(*b*) This amount, or portion thereof, is to be recovered by and is due to Government, if the Tirumalpad is unable to substantiate.
(*c*) This amount, and future amounts due, or portion thereof, will not be paid until the Tirumalpad has established his claim.
* This sum includes Rs. 3,996-3-11 being the amount decreed by the Calicut District Court in July 1924, as being arrears.

to Thacharakavil Tirumalpad of Nilambur.

bamboos.		On junglewood.								Total annual or periodical kuttikanam due.	Total kuttikanam paid.
By purchasers.		Departmental agency.				By purchasers.					
		New clearing at 20 per cent.		General at 50 per cent.		New clearing at 20 per cent.		General at 50 per cent.			
Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.		
									RS. A. P.	RS. A. P.	RS. A. P.
..	..	..	..	..	..	..	..	50	125 0 0	125 0 0	..
..	..	..	..	..	..	..	..	..	..	21 15 7	..
..	..	..	..	..	..	..	..	..	..	53 12 0	(a) 200 11 7
..	..	..	..	..	..	..	..	..	..	33 9 11	(a) 33 9 11
..	..	..	..	..	..	..	..	..	..	1 5 0	(b) 1 5 0
..	..	..	..	..	..	..	..	..	..	(c) 1 4 8	..
..	..	..	..	..	..	..	..	..	..	0 8 0	* 3,996 11 11
..	..	..	..	..	..	..	..	..	..	6,387 0 0	6,387 0 0
..	..	..	..	..	..	..	..	50	125 0 0	6,624 7 2	10,619 6 5

to Karien and paid to the Trickalayur Devaswam.
his claim to Karien.
to Karien.
due by Government to the Tirumalpad, in respect of Karien and Murian.

Statement of kuttikanam due and paid to

Year in which due.	Year in which paid	Mortgage or renewal fee janma-bhogam.	Value of minor forest produce.	On teak, blackwood, etc., trees at Re. 1.		On teak, blackwood, etc., saplings at As. 8.		On planted teak 9 inches and over one-fourth girth at Re. 1.		On Departmental agency.	
				Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number	Kuttikanam.
		RS. A. P.	RS. A. P.		RS. A. P.						RS. A. P.
1862-63 ..	..	..	..	..	..	..	..	..	..	..	..
1864-65 ..	..	..	..	..	..	..	..	..	..	2,500	87 6 3
1865-66 ..	..	..	..	..	..	..	..	..	..	416	14 14 11
1866-67 ..	..	..	..	..	..	..	..	..	..	1,540	44 1 2
1868-69 .	1869-70	..	..	..	..	..	..	..	..	1,100	14 10 0
1870-71 ..	..	..	..	436	436 0 0	..	..	..	..	6,065	(a) 77 8 2
1871-72 ..	..	2 0 0	..	406	406 0 0	..	..	..	..	3,254	(a) 31 13 9
1872-73 ..	1873-74	2 0 0	..	156	156 0 0	..	..	..	..	7,827	(a) 49 3 3
,, ..	1874-75	2 0 0	..	..	..	..	..	..	..	..	..
1873-74 to 1877-78.	1878-79	..	..	869	869 0 0	..	..	..	..	8,237	47 6 8
1877-78 and 1878-79.	1879-80	..	..	280	280 0 0	..	..	..	..	..	..
1883-84 ..	..	..	..	561	561 0 0	..	..	..	..	510	9 12 0
1884-85 ..	1885-86	..	..	380	380 0 0	..	..	..	..	..	..
1885-86 ..	1886-87	..	..	314	314 0 0	..	..	..	..	702	10 11 3
1886-87 ..	1887-88	..	..	..	..	..	..	..	..	1,290	26 9 2
1887-88 ..	1888-89	..	..	..	..	..	..	..	..	..	..
1888-89 ..	1889-90	..	..	..	..	..	..	..	..	..	..
1890-91 ..	1891-92	..	..	434	434 0 0	..	..	..	..	..	..
1891-92 ..	1892-93	..	..	214	214 0 0	..	..	1	(b) 1 0 0	1,984	21 11 2
1892-93 ..	1893-94	..	..	..	..	..	..	..	..	..	..
1893-94 ..	1894-95	..	..	..	..	..	..	..	..	..	..
1894-95 ..	1895-96	..	..	19	19 0 0	..	..	..	..	..	..
1899-1900		..	..	..	..	..	..	..	..	..	..
1900-01 ..	1901-02	..	..	394	394 0 0	..	..	..	..	..	..
1901-02 ..	1902-03	..	..	4	4 0 0	..	..	..	..	58	0 13 11
1902-03 ..	1903-04	..	..	69	69 0 0	..	..	..	..	..	..
1903-04 ..	1904-05	..	..	25	25 0 0	..	..	..	..	..	..
1904-05 ..	1905-06	..	..	14	14 0 0	..	..	..	..	..	..
1905-06 ..	1906-07	..	..	..	..	..	..	..	..	..	..
1906-07 ..	1908-09	..	..	..	..	..	..	..	..	1,300	7 1 9
1907-08 ..	1909-10	..	..	..	..	..	..	28	(b) 28 0 0	1,147	129 12 2
1908-09 ..	1910-11	..	..	2	2 0 0	..	..	..	..	..	..
1909-10 ..	..	..	..	1	1 0 0	..	..	..	..	..	..
1910-11 ..	1912-13	..	..	..	..	..	..	..	..	140	1 5 1
1911-12 ..	1913-14	..	..	7	7 0 0	..	..	191	191 0 0	2,050	23 11 3
1912-13 ..	1914-15	..	..	..	..	..	..	..	..	2,996	59 13 5
1913-14 ..	1915-16	..	..	3	3 0 0	..	..	..	..	3,635	63 2 6
1914-15 ..	..	..	..	31	31 0 0	..	..	..	..	..	..
1914-15 and 1915-16	1917-18	..	..	1	1 0 0	..	..	..	..	289	5 3 7
1916-17 ..	..	..	..	..	..	..	..	1	1 0 0	85	1 7 6
1917-18 ..	1918-19	..	..	..	..	..	..	213	213 0 0	46,912	0 2 9
1918-19 ..	1919-20	..	11 1 0	..	..	..	..	..	..	..	..
1918-19 ..	1920-21	..	..	..	..	..	..	12	12 0 0	61,235	569 11 5
1919-20 ..	1920-21	..	11 1 0	..	..	..	..	..	..	..	..
1921-22 ..	1923-24	2 0 0	11 1 0	..	..	..	..	..	..	..	..
1922-23 ..	1923-24	2 0 0	11 1 0	..	..	..	..	..	..	..	..
1923-24 ..	1923-24	2 0 0	11 1 0	..	..	..	..	..	..	..	..
1922-23 ..	1924-25	..	..	..	..	..	..	..	..	..	..
1923-24 ..	1924-25	..	..	..	..	..	..	5	5 0 0	150	3 0 0
		(f) 12 0 0	55 5 0	4,620	4,620 0 0	..	..	451	451 0 0	1,65,422	..

This lease was terminated on 31st March 1924. A new lease on the basis of the payment of a fixed annual rental of Rs. 700 was entered into from 1st April 1924.

Includes Rs. 200 being 25 per cent of the value of an elephant captured in December 1923.

Reference—

(a) These bamboos are shown as felled from new clearing site for formation of plantation—vide registers of kuttikanam due and paid to janmis.

(b) Out of kuttikanam due at Re. 1 per tree on planted teak in 1891-92 and 1907-08 amounting to Re. 1 and Rs. 28 respectively, kuttikanam was only paid at 8 annas per tree in 1892-93 and 1909-10 respectively and the balance in 1912-13—vide registers of kuttikanam due and paid to janmis and R. Dis. No. 39/12.

Zamorin Raja of Calicut.

bamboos.		On jungle wood.									
By purchasers.		Departmental agency.				By purchasers.				Total annual or periodical kuttikanam due.	Total kuttikanam paid.
		New clearing at 20 per cent.		General at 50 per cent.		New clearing at 20 per cent.		General at 50 per cent.			
Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.		
	RS. A. P.		RS. A. P.		RS. A. P.				RS. A. P.	RS. A. P.	RS. A. P.
500	5 0 0	..	..	..	..	..	..	..	..	5 0 0	..
..	..	..	..	120	190 0 0	..	..	..	..	277 6 3	..
..	..	..	..	..	..	..	..	..	..	14 14 11	..
..	..	..	..	..	..	..	..	..	..	44 1 2	..
..	..	..	..	..	..	..	..	..	..	14 10 0	356 0 4
..	..	..	..	..	130 10 4	..	..	..	..	644 2 6	..
..	..	..	106 11 6	..	..	..	..	..	..	544 9 3	..
..	..	..	..	..	351 0 8	..	..	..	..	556 4 4	1,719 0 1
..	.	..	..	..	..	..	..	..	..	..	2 0 0
..	..	..	..	873	157 8 4	..	..	..	..	1,073 15 0	1,073 15 5
..	..	..	..	664	153 3 5	..	..	..	..	433 3 5	433 3 5
3,087	46 4 10	..	..	541	699 12 7	..	..	..	..	1,316 13 5	..
7,899	118 7 9	..	..	741	924 7 3	..	..	..	..	1,422 15 0	2,739 12 5
320	4 12 9	..	..	612	563 9 5	..	..	..	..	893 1 5	893 1 5
..	..	..	..	..	..	..	..	519	129 12 0	156 5 2	156 5 2
1,000	15 0 0	..	..	..	..	..	..	93	23 4 0	38 4 0	38 4 0
1,000	15 0 0	..	..	..	..	..	..	..	..	15 0 0	15 0 0
100	1 8 0	..	..	357	377 7 3	..	..	62	269 10 3	1,082 9 6	1,082 9 6
1,331	27 7 5	..	..	352	470 6 10	..	..	225	154 11 0	889 4 5	888 12 5
4,771	71 9 0	..	..	..	..	..	..	339	233 1 0	304 10 0	304 10 0
..	..	..	..	..	..	..	..	139	76 13 0	76 13 0	76 13 0
4,302	64 8 6	..	..	..	..	..	..	146	122 11 4	206 3 10	206 3 10
..	..	..	..	705	2,043 0 4	..	..	..	..	(e)2,043 0 4	..
5,000	75 0 0	..	..	26 439	(c) 193 0 7 3,260 6 9	..	..	200	212 8 0	(c)4,134 15 4	3,941 14 9
13,700	205 8 0	..	..	..	..	..	..	446	487 6 2	697 12 1	697 12 1
2,000	30 0 0	..	..	..	..	..	..	514	471 8 4	(d) 570 8 4	(e)2,043 0 4
4,000	40 0 0	..	..	..	..	..	..	641	991 12 6	1,056 12 6	1,820 6 5
4,000	40 0 0	..	..	..	..	..	..	56	20 15 6	74 15 6	74 15 6
1,000	15 0 0	..	..	1	4 10 4	..	..	..	..	19 10 4	12 2 4
..	..	..	..	..	..	..	..	..	..	7 1 9	14 9 9
1,000	10 0 0	..	..	1	1 1 2	..	..	..	..	168 13 4	154 13 4
1,500	22 8 0	..	..	..	..	..	..	..	..	24 8 0	24 8 0
3,000	45 0 0	..	..	..	..	..	..	..	..	46 0 0	..
1,500	27 8 0	..	..	..	..	..	..	..	..	28 13 1	89 5 1
..	..	..	..	2	5 0 0	..	..	..	..	226 11 3	226 11 3
11,000	110 0 0	..	..	..	..	..	..	..	..	162 13 5	169 13 5
5,000	100 0 0	..	..	1	0 8 0	..	..	.	..	166 10 6	166 10 6
2,000	50 0 0	..	..	..	..	..	..	113	603 7 8	684 7 8	..
..	..	..	..	2	6 0 0	..	..	..	..	12 3 7	696 11 3
..	..	..	..	..	..	..	..	7	155 0 0	157 7 9	..
..	..	..	..	..	..	..	..	..	..	213 2 9	(g) 414 14 3
..	..	..	..	..	..	..	..	..	..	..	11 1 0
..	..	..	..	..	..	..	..	..	..	592 12 5	..
..	..	..	..	..	..	..	..	..	..	11 1 0	592 12 5
..	..	..	..	..	..	..	..	..	..	13 1 0	
..	..	..	..	..	..	..	..	..	..	13 1 0	39 3 0
..	..	..	..	..	..	..	..	..	..	13 1 0	
..	..	..	..	12	1 8 0	..	..	..	..	1 8 0	* 209 8 0
..	..	..	..	..	..	..	..	..	..	8 0 0	
79,510	1,140 2 3	..	106 11 6	..	9,533 5 3	..	..	3,500	3,952 8 9	21,166 2 3	21,405 5 3

(c) Out of Rs. 4,134-15-4 being kuttikanam due in 1900-01, Rs. 193-0-7 was only paid in 1904-05—vide registers of kuttikanam due and paid to janmis and R. Dis. No 18/04.

(d) Rupees 570-8-4 kuttikanam due in 1902-03 was only paid in 1904-05—vide R. Dis. No. 18/04.

(e) Rupees 2,043-0-4 kuttikanam due in 1899-1900 was only paid in 1903-04—vide R. Dis. No. 3/04.

(f) Jenmabhogam on account of minor produce for the years 1871-72, 1872-73 and 1874-75 has not been treated as "Kuttikanam."

(g) Includes Rs. 44-4-0 the value of minor forest produce for three years 1914-15, 1915-16, 1916-17 and 1917-18. The amount of Rs. 11-1-0 due annually has never been paid before—vide D. Dis. No. 379/18.

Statement of kuttikanam due and paid to

Year in which due.	Year in which paid or recovered.	Mortgage or renewal fee Jenmabhogam.	Advances recoverable and recovered.	On teak, blackwood, etc., trees at Re. 1.		On teak and blackwood sapplings at Re. 1.		On planted teak 9 inches and over quarter girth at Re. 1.		On Departmental agency.	
				Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam.
		RS. A. P.			RS. A. P.				RS. A. P.		
	1871-72	5,000 0 0	..	..	..	..	..	..	..	..	..
1872-73 ..	1873-74	..	..	43	43 0 0	..	*..	..	..	..	..
1900-01 ..	..	..	..	..	..	..	..	1	1 0 0	..	..
1901-02 ..	1903-04	..	..	12	12 0 0	..	..	1	1 0 0	..	..
1902-03 ..	1904-05	..	..	1	1 0 0	..	..	11	11 0 0	..	..
1903-04 ..	1905-06	..	.	..	..	..	..	12	12 0 0	..	..
1905-06 ..	1906-07	..	..	..	..	.	..	27	27 0 0	..	..
1907-08 ..	..	.	..	..	..	..	..	20	20 0 0	..	..
1908-09 ..	1910-11	..	..	..	..	..	..	43	43 0 0	..	..
1909-10 ..	..	..	..	..	..	..	..	20	20 0 0	..	..
1910-11 ..	1912-13	.	..	9	9 0 0	..	..	41	41 0 0	..	..
1911-12 ..	1913-14	..	..	..	..	..	..	18	18 0 0	..	..
1914-15 and 1915-16 ..	1917-18	..	..	2	2 0 0	..	..	11	11 0 0	..	..
1916-17 ..	1918-19	..	..	2	2 0 0	..	..	147	147 0 0	..	..
1923-24 ..	1924-25	..	..	..	..	..	..	792	792 0 0	..	..
1924-25 ..	Withheld	..	..	..	..	..	..	483	483 0 0	..	..
Total ..		..	..	69	69 0 0	..	..	1,627	1,627 0 0	..	..

When the teak plantations in this block are mature, a considerable sum as kuttikanam will have to be paid within a short period and again have to be paid.

* In 1923-24 the mistake was made for paying for 1911 trees below 9 inches quarter girth, which were removed in thinnings. As the

Naduvath Nambudiri of Wandur.

bamboos.		On jungle wood, etc.											
By purchasers.		Departmental agency.				By purchasers.				Total annual or periodical kuttikanam due.	Total kuttikanam paid.
		New clearing at 20 per.cent.		General at 50 per cent.		New clearing at 20 per cent.		General at 50 per cent.			
Number.	Kuttikanam.	Number.	Kuttikanam.	Number.	Kuttikanam	Number.	Kuttikanam.	Number.	Kuttikanam.	RS. A. P.	RS. A. P.
..	..	..	..	..	..	..	..	..	..	..	5,000 0 0
..	..	..	..	..	..	..	..	..	..	43 0 0	43 0 0
..	..	..	..	..	..	..	..	..	..	1 0 0	..
..	..	..	..	..	..	..	..	..	..	13 0 0	14 0 0
..	..	..	..	..	..	..	..	..	..	12 0 0	12 0 0
..	..	..	..	..	..	..	..	..	..	12 0 0	12 0 0
..	..	..	..	..	..	..	..	..	..	27 0 0	27 0 0
..	..	..	..	..	..	..	..	..	..	20 0 0	..
..	..	..	..	..	..	..	..	..	..	43 0 0	63 0 0
..	..	..	..	..	..	..	..	..	..	20 0 0	..
..	..	..	..	..	..	..	..	..	..	50 0 0	61 0 0
..	..	..	..	..	..	..	..	..	..	18 0 0	27 0 0
..	..	..	..	..	..	..	..	..	..	13 0 0	13 0 0
..	..	..	..	..	..	..	..	..	..	149 0 0	149 0 0
..	..	..	..	..	..	..	..	..	..	792 0 0	* 2,703 0 0
..	..	..	..	..	..	..	..	..	..	483 0 0	* withheld
..	..	..	..	..	..	..	..	..	..	1,696 0 0	8,124 0 0

after a further period of about 70 years. This amount will be within Rs. 20,000. In addition an annual kuttikanam at about Rs. 10 will

Nambudiri refused to refund the excess, the kuttikanam due in 1924-25 (Rs. 483) was withheld. The matter is under correspondence.

Statement of annual lease payments to janmis.

Year in which due.	Year in which paid.	To Uralan, Trickalayur Devaswam. Amount due.	Amount paid.	To Zamorin Raja of Calicut. Amount due.	Amount paid.	Total.
		RS.	RS.	RS.	RS.	RS.
1916-17	1917-18	1,500 0 0	1,500	..	..	..
1917-18	1917-18	1,500 0 0	1,500	..	..	3,000
1918-19	1918-19	*1,281 12 5	1,500	..	..	1,500
1919-20	1919-20	1,281 12 5	1,500	..	..	1,500
1920-21	1920-21	1,281 12 5	1,500	..	..	1,500
1921-22	1921-22	1,281 12 5	1,500	..	..	1,500
1922-23	1922-23	1,281 12 5	1,500	..	..	1,500
1923-24	1923-24	1,281 12 5	† 1,042	..	..	1,042
1924-25	1924-25	1,281 12 5	1,042	700	700	1,742
1925-26	1925-26	1,281 12 5	1,042	700	700	1,742
1926-27	1926-27	1,281 12 5	1,042	700	700	1,742
	Totals ..	14,535 15 9	14,668	2,100	2,100	16,768

* As a result of the court decree of July 1924, it was decided to reduce the annual rent from Rs. 1,500 to Rs. 1,281-12-5 with effect from 1918-19.

† No payments have been made to the uralan from 1923-24 onwards. The sum of Rs. 1,042 represents the amount to be recovered annually from the uralan on account of the loan of Rs. 12,000 made in 1917. From 1923-24 onwards, it has been paid to the Collector of Malabar for adjustment.

208. *Determination of the cost value.*—In the case of leased forests the calculation is made by discounting, at 3½ per cent compound interest, to the year in which each lease was executed, the past and future payments of kuttikanam and annual rentals. The calculations refer to past payments only, in the case of forests in the absolute possession of the State.

I.—Trickalayur Devaswam lease and Thacharakavil Tirumalpad of Nilambur lease.—The area under these two leases is 12,251·8 acres. Final settlement of disputes, as regards ownership, are pending. Mr. Bourne calculated the present value, in 1840-41, of all past and likely future payments, to be Rs. 17,667 or Rs. 1,442 per acre. The value can be recalculated when the disputes are finally decided.

II.—Zamorin Raja of Calicut lease covers Nellicutta, comprising 1,999 acres.

Lease executed on 10th November 1841, and revised on 30th September 1924.

Mr. Bourne calculated the present value, in 1841-42, of all payments up to 1918-19, to be Rs. 3,613.

To this must be added the present value, in 1841-42, of payments of kuttikanam from 1919-20 to 1924-25, and of the rental of Rs. 700 due every year for ever.

The present value, in 1841-42, of Rs. 11 paid in 1919-20 = Rs. 0·7.

[log Co = log Cn — 78 × log 1·035
log Co = 1·04139 — 78 × 0·01494
log Co = 1·04139 — 1·16532
log Co = $\bar{1}$·87607
Co = 0·7517]

Similarly, the present value, in 1841-42,
of Rs 593 paid in 1920-21 = Rs. 39·1
of Rs. 39 paid in 1923-24 = Rs. 2·3
of Rs. 209 paid in 1924-25 = Rs. 12·0
The sum of the present values, in 1841-42, of kuttikanam paid from 1919-20 to 1924-25 = Rs. 94·6

A rental of Rs. 700 is due in 1924-25, and again every year, for ever. Its present value, in 1924-25, at 3½ per cent $= \frac{\text{Rs } 700}{0 \cdot 035}$ = Rs. 20,000.

The present value, in 1841-42, of Rs. 20,000 in 1924-25 = Rs. 1,151.

The present value, in 1841-42, of all sums paid and to be paid in respect of this lease, for 1,999 acres, is, therefore, Rs. 3,613 + Rs. 94·6 + Rs. 1,151=Rs. 4,859 or Rs. 2,431 per acre.

III.—Naduvath Nambudiripad of Wandur lease.—This lease covers the Chatomborai block of 650·0 acres, and was executed on the 6th April 1871. Mr. Bourne calculated the present value, in 1871-72, of all sums paid and estimated to be paid

in future, to amount to Rs. 6,741 or Rs. 10·371 per acre. This figure may be accepted as the cost value of the land, until the present dispute about kuttikanam is settled.

IV.—Karumpoya and Old Amarampalam.—Area 4,511·5 acres. (The forests are State-owned.)

These areas were leased, in April 1872, from the Edavanna Kovilagam. Rupees 80,000 was paid in cash; Rs. 10,000 for the plantation 1861–68 in Old Amarampalam, and Rs. 70,000 for the balance.

The following additional payments were made, prior to the final acquisition of the land:—

(1) An annual jenmabhogam of Rs. 100 was paid regularly from 1873–74 to 1885–86, both inclusive.

The present value, at the beginning of 1872–73, of a rental of Rs. 100 due every year commencing from 1873–74, altogether 13 times, at 3½ per cent = Rs. 100 × 10·31 × 0·9662 = Rs. 996.

(2) Jenmabhogam of Rs. 300 was paid in 1888–89, Rs. 100 in 1889–90, and Rs. 200 in 1892–93. In 1892–93 the jenm title to the land was purchased for Rs. 2,501. The present value, at the beginning of 1872–73, of such payments = Rs. 300 × 0·5767 plus 100 × 0·5572 plus 2,701 × 0·5026 = Rs. 1,587.

The present value, in 1872–73, of all amounts paid for the acquisition of the above area, or 4,511·5 acres = Rs. 82,583 or Rs. 18·305 per acre. [R. Bourne.]

V.—New Amarampalam.—Area 61,744 acres. (The forest is State-owned.)

This area was purchased from the Edivanna Kovilagam in public auction on 19th December 1887, and the sale for Rs. 42,000 confirmed on 20th February 1888.

In 1896, Rs. 4,821–13–8 was paid as compensation for improvements on the Talikolli lands. The present value of this sum, in 1887–88, amounted to Rs. 4,822 × 0·7337 = Rs. 3,538.

The present value, in 1887-88, of all amounts paid for the acquisition of the above area, or 61,744 acres = Rs. 45,538 or Re. 0·738 per acre. [R. Bourne.]

PART II.

FUTURE MANAGEMENT DISCUSSED AND PRESCRIBED.

CHAPTER I.—BASIS OF PROPOSALS.

209. *Factors which indicate the future policy.*—Both the climate and the soil of the Nilambur valley are eminently suitable for the growth of large timber. With the exception of the forests on the ghauts, the timber-bearing areas are extremely well placed from the point of view of extraction. Transport by water to the coastal markets, is comparatively cheap, and within the last year a railway has been opened. The latter is within two miles of the nearest of the Government forests, and is only ten to twelve miles distant from the nearest of the natural forests, in which rapid development is practicable. The forests are thus placed in direct communication, by rail, with the important inland markets. The great value of the teak plantations has now been amply demonstrated, and there can be no hesitation in maintaining them, and in extending them, provided that the localities selected are suitable for teak, and are reasonably accessible. From the point of view of demand, there may be a limit to the acreage which should be put under pure teak, but no such limit is in sight. The demand for big timber is increasing, while the supply (especially of teak) is diminishing. Vast tracts of the more accessible forests are unsuitable for teak, but they can, and do, produce big timber of other valuable species. To yield a really high profit, large scale exploitation must be intensive. It is therefore advantageous to replace the existing mixed irregular forests of all species (valuable and inferior) by even-aged woods of the most important timbers. As regards the artificial regeneration of species other than teak, the knowledge acquired, up to the present, is insufficient to justify rapid extension. It is desirable, however, to extend such experimental work as appears promising, by undertaking the regeneration of several species on a moderate scale, with a view to investigating the possibilities of early expansion. Conversion to regular forests, without resorting to artificial regeneration, is obviously desirable, wherever conditions permit. Finally, in areas where conversion of the existing irregular forests cannot be undertaken in the near future, there is much mature and overmature timber which should be removed and turned into money while it is still sound.

210. *General objects of management.*—The main object of management is to obtain, from the soil, the highest possible net return per acre per annum, within the shortest possible time, and to maintain this maximum money yield in perpetuity. The silvicultural requirements of the crops must be considered, and the productivity of the soil must be maintained. These latter objects will, however, be attained, provided the management continues to aim at a sustained yield. The last, but none the less important, object of management is the prevention of erosion, and the regulation of the water-supply. Vast areas of most valuable crops in the plains could be ruined by floods, and further silting of the rivers would affect water transport most injuriously.

211. *Means of attaining the objects of management.*—The extreme accessibility of the existing teak plantations, and their immense financial value, justify the most intensive treatment. They should be tended with the object of growing, in the shortest possible time, without reducing the total production per unit of area, crops, the individual trees of which have acquired the highest degree of value to be expected in each locality. The quality of the locality must be maintained by a suitable understorey. When finally felled, the plantations must be regenerated immediately. Re-stocking should be with teak, in all areas where good second crops of this species can be grown, and with other valuable species elsewhere. The large areas, where second rotation crops have failed, must be reafforested as soon as possible, since every acre is of the utmost potential value. Teak, being the most valuable species, should be reintroduced in the better areas of this category, and other valuable species in the poorer. The failed teak areas of the first rotation are to be maintained as regular forests of miscellaneous valuable species, adopting artificial regeneration

where necessary. The irregular natural forests of the plains and foot-hills should be converted to regular forests as soon as possible. The most suitable and accessible areas should be planted with teak, and the provision of a good understorey must be considered from the outset. Where conversion without artificial regeneration is possible it should be undertaken at once. Artificial regeneration, in localities unsuitable for teak, should be on a small scale, until cheap and successful establishment of crops of miscellaneous valuable species can be assured. Such artificial regeneration should be confined, for the present, to the natural forests where the existing crops are least worthy of the quality of the locality. In natural forests where conversion cannot be undertaken in the near future, mature timber should be removed. Finally, in order to prevent erosion, and to regulate the water supply, the ghauts forests are not to be worked under the provisions of this working plan, and the necessity of considering these questions is emphasized in the event of such working being contemplated in future. All the working plan prescriptions, if properly executed, will tend towards the attainment of normality in the forests to which they apply. The normal forest is, however, a long way off, in most parts of the tract dealt with.

212. *Methods of treatment to be adopted.*—In the existing teak plantations, the general method of treatment will be clear-felling, followed by artificial regeneration with teak. Some modifications of the general method will be made where necessary, to suit particular conditions. Areas on which planted teak has failed, and which are unsuitable for teak, will be tended as regular forests of miscellaneous species. Artificial regeneration will be undertaken in such areas as have not, and are unlikely to become stocked with miscellaneous species by natural means. Failed areas suitable for teak will be re-stocked with that species. The irregular natural forests will be converted to regular high forests of the most valuable species, in the cheapest way and as soon as possible. The best and most accessible localities will be clear-felled and artificially regenerated with teak. Conversion, without artificial regeneration, will be undertaken where the condition of the crop makes such a course possible. Artificial woods of various valuable species will be raised, in various ways, on a small scale in the first place. The various subsidiary methods of treatment aim at the improvement of the growing stock, and the realization of revenue which would be lost if recent methods of treatment were to be continued.

213. *Working circles, their area and distribution, reasons for their constitution.*—Three Working Circles were formed at the last revision of the working plan. For convenience of prescription and control, two further Working Circles will be formed and the five will be as follows:—

(i) *Plantation Working Circle.*—This Working Circle embraces all areas planted with teak from 1843 to 1912, some of which have been clear-felled and re-planted, and a few small areas within the plantation boundaries which have either been left unplanted or have been planted with species other than teak. It contains an almost complete series of age gradations of teak woods, for the rotation in force, with a few plantations above rotation age. Its total area is 6,560·6 acres.

(ii) *Conversion Working Circle.*—The area of the Conversion Working Circle is 24,877·0 acres, of which 1,017·1 acres have been planted, mostly with teak, with varying success. The balance of 23,859·9 acres comprises all the natural forests (including swamps) which are reasonably accessible for exploitation by existing methods; and extraction by the existing system of communications, and for concentrated regeneration.

(iii) *Inaccessible Working Circle.*—The Inaccessible Working Circle covers an area of 48,299 acres, and comprises all the remainder of the natural forests, high level grass lands, precipices, etc., which are at present inaccessible for the above purposes.

(iv) *Bamboo Working Circle.*—The Bamboo Working Circle covers the whole area of the Nilambur division, wherever bamboo occurs. It is only the areas of easiest access, however, that are usually worked.

(v) *Minor Produce Working Circle.*—This Working Circle, also, covers the whole working plan area.

214. *Period of working plan and necessity for intermediate revision.*—The working plan will have effect from 1st April 1928 till 31st March 1937. But if, after four years, it is found that the proposals for treating second rotation teak crops are unlikely to insure financial success, this question must be re-examined, and suitable modifications of the plan must be framed. In this event (which the writer considers remote) the most obvious course would be to confine final felling to the poorest of the old plantations, and to regenerate them with valuable species other than teak, whilst taking energetic steps to introduce a soil-improving underwood in the better localities. As regards revision at the end of the 10-year period, it is necessary to point out that the present revision has occupied the Working Plans Officer for two years and four months. It is therefore advisable to allow plenty of time for the next revision, especially as stock-mapping of all the plantations will be desirable.

CHAPTER II.—WORKING PLAN FOR THE PLANTATION WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTER OF THE VEGETATION.

215. *Area.*—The Plantation Working Circle covers an area of 6,560·6 acres, after the exclusion of one compartment which has been permanently transferred to the Forest Research Officer.

216. *General constitution.*—It consists of areas cleared and planted with teak (successfully and otherwise) from 1843 to 1912, small areas included within the plantation boundaries but left unplanted at the time of formation, and a few very small areas in which species other than teak have been planted.

217. *General character of the vegetation.*—In the better localities, the overwood consists of practically pure teak, and the underwood is usually insufficient or absent (especially in the older plantations). In poorer teak localities, there is a certain natural admixture of other species, sometimes in the upper canopy, but more usually in the understorey. In the localities least favourable to teak, the latter has been practically suppressed and replaced by inferior species—such are the failed areas of the first rotation. The second rotation teak crops are generally very much inferior in quality to those of the first rotation. Large areas have failed, for administrative reasons, and areas of lesser extent have failed owing to climatic causes and unsuitable soil conditions. Detailed descriptions of all the crops, underwoods and undergrowth will be found in the history and description of compartments, and all the prevailing conditions of growth have been discussed at some length in Part I, Chapter II.

SECTION 2.—PERMANENT DIVISION OF THE AREA.

218. *Blocks.*—The Plantation Working Circle is distributed over several blocks, known by local names. In some cases whole blocks, in other cases only parts of blocks are included within the plantation area.

219. *Plantations.*—The area cleared and planted in each year is known as the plantation of that year, and, according to the name of the block in which it is situated, it is described, for instance, as Edacode 1857, Pannengode 1854, etc. The plantations of the second rotation are similarly styled, except that both years of formation figure in the description, for example, Edacode $\frac{1847}{1927}$, Elenjeri $\frac{1845}{1919}$, etc.

220. *Compartments.*—Three hundred and forty-four permanent compartments were formed when the last working plan was made. One of them (compartment 120) has been handed over to the Forest Research Officer as a permanent experimental area, and is now omitted from the working circle. Compartments 10 and 11, and parts of compartments 9 and 12 have been handed over to the Malabar Special Police for temporary occupation. They are retained in the Working Circle, but no treatment will be prescribed for them. Thus the Working Circle consists of 343 permanent compartments. Their average area is between 19 and and 20 acres, and their size varies from over 60 acres to something less than two

acres. Most of the compartment boundaries are artificial (firelines and roads); in some cases well-defined streams have been utilized, and in a few instances the limits of cultivated land (marked by survey stones) are taken as boundaries. Boards, inscribed with the appropriate numbers, are nailed on trees at the corners of compartments.

SECTION 3.—TEMPORARY DIVISION.

221. *Sub-compartments.*—For purposes of description and treatment, Mr. Bourne divided the compartments into sub-compartments according to the quality of growth (as determined from his yield tables), the density of the crop, and the species occurring. Sub-compartments have been marked on the maps, but have never been laid out on the ground. In revising the working plan the writer has stock-mapped only the best of the second rotation crops (i.e., the plantations of 1917 and 1918) and the sub-compartments so formed have been marked on the new maps. He has, further, surveyed and mapped the failed areas which are proposed for special treatment, and all failed areas in second rotation plantations. The remainder of the mapping of qualities in first rotation crops has been copied from the 1918 maps, for, though it was realized that changes of quality had occurred in the past ten years, it was agreed that, inasmuch as a revision of the qualities would not affect the actual prescriptions of the working plan, neither the expenditure on re-mapping, nor the consequent delay in completing the working plan would be justifiable. The sub-compartments are denoted by letters *a*, *b*, *c*, etc. The letter *m* has invariably been used to distinguish the sub-compartments of the Miscellaneous Felling Series.

222. *Felling series.*—The Working Circle is now divided into two Felling Series, the Teak Felling Series and the Miscellaneous Felling Series. It is agreed that it is not strictly correct to consider the latter as forming a Felling Series, but it is convenient, for many reasons to do so. The Teak Felling Series consists of (i) the areas on which teak has been more or less successfully planted (4,497·9 acres), (ii) most of the small areas within the plantations which have not been planted at all, or have been planted with other species (204·2 acres), and (iii) the failed teak areas which it is not proposed to treat specially during the ensuing period (394·1 acres). The Miscellaneous Felling Series is made up of (i) the areas, on which teak has failed, and which are considered suitable for special treatment—either tending the existing crops of miscellaneous species, or introducing new crops of species other than teak, and (ii) a few of the unplanted areas and areas planted with species other than teak. Its extent is 976·9 acres. The constitution of the Miscellaneous Felling Series is of a purely temporary nature. It will have to be enlarged at the next revision of the working plan, when it should be possible, and probably will be desirable, to consider it either as a separate Working Circle, or as a part of the present Conversion Working Circle or of one of its future subdivisions. It must be explained why *any* of the failed areas have been retained, for the present, in the Teak Felling Series. There are several reasons. Many of these areas are of such small extent or are so narrow that it would not be practicable to treat them as units. (Only where they fall within teak plantations due for regeneration, have the smallest of the failed areas been added to the Miscellaneous Felling Series.) Secondly, a number of the failed areas are in suitable teak localities, their failure being due to administrative reasons or to abnormal conditions. Thirdly, where the only suitable treatment is clear-felling and planting, and where these areas occur in teak plantations to be felled within a reasonable period, it has been thought most fitting to neglect them for the present, especially as it seems certain that such areas will be enlarged by the addition of the poorest of the adjacent teak plantations. Lastly, certain failed areas have been left in the Teak Felling Series because they are unfit to carry trees of any species, or because the writer cannot think of any suitable treatment.

SECTION 4.—ANALYSIS AND VALUATION OF THE CROP.

223. *Stock-mapping.*—As explained in the preceding section, stock-mapping, at this revision of the working plan, has been confined to the survey and mapping of qualities in the 1917 and 1918 plantations, of the failed areas which constitute the Miscellaneous Felling Series, and of all failed areas in the plantations of the second rotation. Mr. Bourne's mapping of practically all the other parts of the first rotation

plantations has been accepted, for reasons already stated. The error involved in this procedure is bound to be an exaggeration of the extent of the areas of better quality. This error will, however, be compensated by the procedure adopted in the case of the majority of the second rotation teak crops. All second rotation areas, on which teak has been more or less successfully established from 1919 to 1927, have been considered as III quality. Such classification is a fair description of most of them, though a thorough examination would show that there are also small areas of II quality. In deciding the limits of quality (where this has been done) the height of the dominant trees has been taken as the indicator, and the limits of height for age have been taken from Mr. Bourne's yield tables and height curves.

224. *Description of compartments and valuation of the growing stock.*—The nature and density of the main crop, the underwood and the undergrowth have been examined, and are described in the description of compartments. The stand of teak in each sub-compartment has been determined from Mr. Bourne's yield tables and the writer's estimate of the density, and these figures have also been recorded.

225. *Summary of quality and age class table.*—In order to determine the annual coupe, and to allot compartments for final felling, a quality and age class table has been prepared. It is a lengthy statement and there is no particular reason for reproducing it in full. The following is a summary, by ten year age classes :—

Age class.	Total area.	Unproductive area.		Teak felling series.								Miscellaneous felling series.
								II quality.		III quality.		
		River bank.	Roads and fire lines.	Unplanted.	Planted with other species.	Failure.	I quality.	Actual area.	Area reduced to I quality.	Actual area.	Area reduced to I quality.	
YEARS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.	ACS.
0–10 ..	964·9	73·3	19·1	37 3	0 6	102·7	2·7	48·4	36·1	465·0	226·8	215·8
11–20 ..	659·4	50·4	11·5	4·6	..	60·0	131·5	238 7	178·1	77·4	37·8	85·3
21–30 ..	1,157·0	43·6	19·2	50·4	..	43·0	208·5	462·3	345·0	176 2	86·0	153·8
31–40 ..	1027·1	52·9	19·6	50·0	9·8	38·7	73·2	273 9	204 4	368·2	179·6	140·8
41–50 ..	181·6	5·9	3 8	..	3·8	1·9	24·9	35 4	26·4	81·0	39·5	24·9
51–60 ..	1,238 4	68·9	20·1	25·2	..	108·8	90·1	280.9	209·6	492·9	240·4	151·5
61–70 ..	798·5	55·3	11·1	18·8	0 1	27·7	49·5	256·3	191·3	349·8	170·9	29·9
71–80 ..	389·8	18·4	7·0	2·3	0·9	4·1	12·3	406·7	79·6	149·4	72 9	88·7
Over 80 ..	143·9	6·1	1·3	0·4	..	7·2	8 1	24·8	18·5	9·8	4·8	86·2
Total ..	6,560·6	374·8	112·7	189·0	15·2	394·1	600·8	1,727·4	1,289 0	2,169·7	1,058·7	976·9

NOTE.—i. Compartments clear-felled in 1927 (for planting in 1928) have been shown as 0 years of age, and the qualities of the first rotation crop given.

ii. To reduce II and III qualities to I quality, divide by 1·34 and 2·0 5 respectively (based on Mr. Bourne's yield tables).

SECTION 5.—TEAK FELLING SERIES—METHOD OF TREATMENT.

226. *Choice of species.*—The writer is extremely doubtful whether a profitable second crop of teak can be raised in the poorest teak localities. At the same time, efforts to introduce other species, as second rotation crops, have been even less successful than re-planting with teak. A few of the poorest teak areas, where there is a reasonably good understorey of Xylia xylocarpa, have now been selected for final felling of the teak, and retention of the natural Xylia as the future crop. Experiments in raising a crop of teak coppice after final felling, with the idea of introducing a different species under the shade of the coppice at a later date, will be prescribed for immediate trial. If the results are promising, the management may extend the method to similar localities in future. A few of the teak areas due for final felling are so unpromising (at present) for the introduction of any species, that there seems no option but to fell the teak (which is rapidly declining) and to hope for some return from coppice. Apart from such exceptions, and until special tending of second rotation crops has had a full trial, teak will be the species chosen for regeneration in the Teak Felling Series. To this general statement there must be added one *proviso*. Small areas of indifferent drainage are common in the plantations, and they often tend to become too swampy for teak after final felling. Terminalia tomentosa will be introduced in such areas if teak cannot be raised.

227. *Silvicultural system.*—Attempts to obtain natural regeneration of teak, in the Nilambur plantations have either failed, or have proved much less successful and not appreciably cheaper than artificial regeneration. The main system will therefore be high forest clear-felling with artificial regeneration. (Exceptional areas have been referred to in the last paragraph.)

228. *Rotation.*—From his yield tables and the prices prevailing in 1918, Mr. Bourne calculated the financial rotation to be 46 years for teak woods of I quality, 52 years for II quality, and 53 years for III quality. (The rate of interest adopted was $3\frac{1}{2}$ per cent). He then fixed a general rotation of 70 years for all qualities. There has been considerable fluctuation in prices since then, and the timber market is, as yet, far from stable. No attempt has therefore been made, at the present revision, to recalculate the financial rotation. If such a calculation were made, and if present prices were adopted, there is no doubt that the financial rotation would be somewhat longer than that calculated by Mr. Bourne, owing to the diminished value of the intermediate yields. There is, at the present time, no case for altering the rotation in force, for it is found that the plantations being felled now (most of them are slightly over 70, and the same will be the case in the ensuing period) yield the classes of timber which are most in demand. The general rotation will therefore be 70 years. In order to test the desirability of a considerably longer rotation for the best teak woods, one compartment of exceptionally good growth (aged 81 years), is being retained.

229. *Regulation of the yield.*—With the future of the second rotation crops in doubt (as it is) the most desirable method of regulating the yield is one which will ensure an equal annual supply of big teak timber to the market, for as long a period as possible. The formula $\frac{\text{Area}}{\text{Rotation}}$ as well as being the simplest formula and that most usually adopted in the system of clear-felling with artificial regeneration, will go as near to achieving this aim as will any other, provided that the calculations are made with equiproductive rather than with actual areas. The yield will therefore be regulated by area. The total area under teak will be reduced to I quality and the figure so obtained, divided by 70, will be the reduced area of the annual coupe. This procedure should give a sustained yield for the next 70 years or so. Differences between annual yields will depend on the differences in density of the crops for final felling, and on such depreciation in quality as occurs in future. Neither of these reasons should operate in the near future, for the old plantations are really very similar, and having long since passed the period of maximum growth, their quality is unlikely to alter. And when what are now comparatively young plantations come to maturity, it is hoped that they will be more fully stocked than the present old plantations, so that any depreciation in quality should be compensated by an increase in density, and thus the yield will be sustained. From the summary of quality and age classes in paragraph 225, it is seen that the total area under teak, reduced to I quality, is 2,948·5 acres. This figure, divided by 70, makes the reduced area of the annual coupe 42·12 acres, and the area (in terms of I quality) to be felled in the ensuing 10 year period is 421·2 acres.

Prescriptions.

230. *Marking for final felling.*—The exploitable trees, in the compartments to be felled, shall be serially numbered, at breast-height, before felling. Marking shall be restricted to teak and to the most valuable specimens of miscellaneous species only. The bulk of the adventitious species must be kept for burning. The girth at breast-height shall be measured, the height of exploitable bole estimated, and details entered in an enumeration register. Not less than 10 per cent of the enumeration shall be checked by a gazetted officer.

231. *Marking of compartment boundaries.*—Where two or more adjacent compartments are to be clear-felled, the dividing compartment lines shall be clearly marked before felling, by driving posts into the ground at suitable intervals. These marks must be maintained while Clearing and regeneration are in progress.

232. *Final felling.*—Felling shall be commenced at the end of the monsoon and be completed expeditiously. Trees shall be felled with as little wastage as possible. They should all be felled in one direction so as to minimise the chances of breakage.

Cross-cutting of logs, when necessary, shall be done by saw. The preliminary measurement and classification, by the subordinate in charge of each felling area, shall be undertaken on the day of felling, and the stumps shall be chiselled with the serial numbers of the trees felled. The daily felling register shall be posted on the day of felling, and the outturn shall be recorded separately for each compartment. Final measurement and classification shall be done with the least possible delay. Crown and branchwood, which cannot be utilised as timber, shall be converted, *in situ*, into spokes and felloes (or small pieces for similar purposes) to the extent of such demand as exists. (Teak is a poor firewood, and the profusion of chips left after this kind of work is likely to give a better fire than can be obtained from burning the branchwood whole.) No timber shall be removed from stump-site until the final classification in each compartment is completed and has been checked.

233. *Clearing the area.*—Whether elephant or mechanical haulage is employed in future, all saleable material must be removed from the felled areas, as soon as possible after final classification. It has recently become a practice to store timber within the felled areas. This means that stacking sites cannot be planted up until the year following that in which the rest of the compartment is regenerated. Unless such a course is absolutely unavoidable, this practice must be stopped. Stacking sites should be as near the rafting places as possible, consistent with safety from loss of logs by high floods or easy theft. They should not be located in young plantations. As soon as the saleable timber is removed, clear-felling of the remaining growth of trees and larger shrubs shall be commenced. There is, as a rule, little material for a burn on these areas, and it is important to make the most of what exists. To give the material ample time to dry, felling must be completed by the end of December at the latest. Chips resulting from the conversion of spokes and felloes shall be strewn over the area, so as to facilitate the spread of the fire. (From local information it is understood that this was done in 1917, and the only good burn obtained in the plantations was in that year.) The debris shall be fired at the end of February, or at least not later than the middle of March. Material incompletely burnt shall be cut up, collected, piled and burnt to ash immediately after the original burn. This heaping and re-burning shall be done on areas to which the first fire has not spread, so that all parts of a compartment shall have the benefit of as much burning as is possible.

234. *Collection of seed.*—It is most important to use the very best seed obtainable. In recent years seed has sometimes come from very doubtful sources, and some of the poorness of the second rotation crops must be due to this factor. The suitability of seeds from different localities is being tested by the Research branch, and advice in this matter should soon be available. The fact is that, though sufficient good seed can be obtained locally for the requirements of the Plantation Working Circle, the problem of the additional supply of good seed for large clearings in the Conversion Working Circle is acute. There seems little doubt that part of the future supply of teak seed will have to come from sources outside the Nilambur forests. The best seed is usually the biggest, though to what extent one can select seed from the size of the fruits (each containing a varying number of seeds, from one to three) the writer is not at all sure. It seems reasonable to suppose that greater vigour can be expected from the larger fruits. The smallest fruits should not be collected. February is the usual month for collection. Fruits shall be collected only from trees with long straight boles and large crowns, which are not younger than middle age. It is not pretended that such trees are very plentiful, but they are to be found in the vicinity of the following places in the natural forests, and possibly in others :—Kariri, Pulimunda, Padukka, Chalikal, and parts of Nellicutta. In collecting seed from the plantations, great care must be exercised to select only the best seedbearers, as described above. Such are to be found, scattered, in the following localities, and to a less extent in various other places :—Nellicutta 1871 and 1870 plantations; Puthalath-Chittarikal and Pozhayi-Mangalasseri parambas (particularly the former); Old Amarampalam compartments 223 and 224, near the river; and Aravallikava compartment 3a. Three Palghat paras of seed, for every acre to be planted, gives an unnecessarily large margin of safety in all ordinary years. It is advisable, however, to collect seed on this scale, if possible, though not more than 2 paras need be sown in the first instance. The balance can be kept in reserve, in

case germination is bad, and if the seed is not required in the year of collection, it can be stored till the next year. (Germination is often better in the second than in the first year.) After an examination of the area to be regenerated each year, sufficient seed of Terminalia tomentosa shall be collected to stock any parts which seem likely to turn swampy.

235. *Nurseries.*—Unless and until it is definitely established that any other method of formation is preferable to that of planting nursery transplants, the latter will be the main method of regeneration in the Teak Felling Series. Since small plants are desired, there is no need to go to the expense of digging nursery soil to a depth of 2 to 3 feet as prescribed by Mr. Bourne, and his dates for sowing are possibly too early, in normal years. Uprooting stumps in nursery sites constitutes an unnecessary expense. Nurseries shall be dug out to a depth of one foot, and cracks will be made, with a pick-axe, in the lower soil, to ensure drainage. The excavated soil will then be powdered and replaced, and the beds will be raised to the height allowed by the quantity of loose soil available for each bed. The sides and ends of the beds shall be supported by split bamboos, and the surface of the beds shall be levelled. The beds shall be 3 feet wide, with a space of one foot between them, to allow of easy passage for coolies engaged in nursery work. It is considered quite safe to rely on getting 4,000 good seedlings in every 50 feet of bed of this width. The seed will be soaked in cold water for 48 hours before sowing. Plants of the most suitable size at the time they are required, will probably be obtained by sowing half the seed about the 24th of April, and the remainder a week later. (It may even be found desirable to sow the nurseries in three instalments.) The seeds will be spread over the beds, touching one another, and will be covered with a layer of finely powdered soil to a depth equal to the thickness of the seeds. The beds will then be covered with scattered twings of Phyllanthus Emblica (or similar twigs) and finally with a layer of straw. (The twigs prevent the straw being washed down into the soil, and facilitate removal of the straw without damage to germinating seeds.) The beds will be watered on top of the straw daily. As soon as germination commences the straw must be removed. Daily watering will be continued, except on rainy days or days on which the beds are obviously moist enough, until the monsoon sets in. Proper watering cans should be used. Any tendency of the soil to become caked on the surface must be corrected by gently loosening it with a pointed stick, taking great care not to disturb the seedlings or germinating seeds.

236. *Aligning and staking*—The espacement shall be 6′ × 6′. Guide lines shall be laid out parallel to, and at right angles to straight fire-lines, where such are available. In other cases, as many straight guide lines as are required shall be laid out by compass. These lines must intersect at right angles. A good method of lining out a new clearing is described in the Madras Forest Pocket book. It should be followed, with such modifications as are necessitated by the existence of fixed straight lines in the form of compartment boundaries. It is possible that in areas devoid of weed growth, the planting distance can be marked more cheaply by cutting out clods of earth than by driving in stakes. The difference in cost is, however, slight, and the importance of facilitating inspection of the results of regeneration must always be remembered. Accuracy of lining is always desirable, and is absolutely essential in areas that are to be ploughed. Except in any areas where it may be found possible to dispense with stakes, as suggested above, bamboo stakes, about 2½ feet long, will be used, and must be hammered firmly into the ground. Careful supervision of lining is necessary, until the present high costs are reduced. The work must be undertaken as soon as the regeneration areas are cleared and burnt.

237. *Loosening soil at stakes.*—Prior to 1927 (in which year teak stumps were planted in crowbar holes), it was the practice to dig pits, one foot cube, and to replace the earth before planting. The work was extremely expensive (Rs. 6 to Rs. 8 per acre), and if much stress was laid on the actual measurements of the pits, the coolies became recalcitrant! It is believed that equally good results can be obtained by loosening the soil with a pick-axe. This method shall therefore be adopted, and pitting will not be reverted to, unless the results indicate it. Pick-axes which will penetrate to a depth of one foot shall be used, and the soil must be loosened in a square of at least one foot (or more, if little extra cost is involved).

This work must be completed by the end of May, in the case of areas to be planted, and by the middle of April for direct sowing. Close supervision will be required, as the operation is not susceptible to check-measurement.

238. *Formation.*—The importance of getting each area *completely stocked in the first year* cannot be over-emphasized. *One hundred per cent must be the measure of successful regeneration.* It is also very important to establish the crop as early in the season as possible, and it is with this object in view that experiments with direct sowing are prescribed. If the method proves more suitable than planting, it will be adopted in preference to the latter. At first, however, planting will be the main method.

(*a*) *Planting.*—Mr. Bourne laid great stress on early planting, i.e., during the first burst of the south-west monsoon. It is common for the first rains of the monsoon to be weaker, of shorter duration, and followed by a longer dry period, than is the case a little later in the rainy season. Very heavy casualties are the invariable result of such conditions, in the case of seedlings planted in the last three days before the rain stops. A perusal of old rainfall registers, however, shows that an early break in the monsoon is not by any means inevitable. This being the case, and since the areas to be dealt with are small, and planting is a cheap operation, it is prescribed that all available labour shall be concentrated on planting in the first downpour of the monsoon, and the work shall be completed within three days. If the work is unfinished within this time, the District Forest Officer may use his discretion about postponing the remainder of the planting till after the first break in the monsoon. Planting shall be undertaken on rainy days only. The smallest plants usually give the best results, i.e., plants with two pairs of secondary leaves above the cotyledons, down to those with only the cotyledons developed. (The latter may be planted either with or without the seed attached.) If larger plants have to be used, all leaves, except the top pair, should be nipped off (not *pulled* off) close to the stem, as soon as the plants are dug out of the nursery beds. Large plants should always be discarded if they have thin, weedy stems ; for such, if they survive at all, give the poorest results. There is no need to describe the technicalities of planting, for these are known to every officer, and, in fact, to the local coolies themselves. What *is* required is close supervision, to see that the work is properly done. The District Forest Officer must personally supervise as much of the regeneration work as he possibly can, and continuous supervision by Range Officers and their subordinates is absolutely essential. After each break in the monsoon, casualties will be replaced. The first replacement will often be heavy, but thereafter, if the work has been well and expeditiously carried out, casualties should be light. The manner of introducing Terminalia tomentosa, in such areas as become too swampy for teak, is not rigidly prescribed. Good results are obtained at Mount Stuart, in two ways. Firstly, by sowing seeds at stakes, along with the teak, in doubtful places, and secondly, by putting out heaps of seed (' dumps ') and planting the germinating seeds and small plants obtained therefrom. Teak nursery sites shall be left fully stocked at a rough espacement of 6′ × 6′ by the end of the planting season. If whole beds of seedlings are dug out, the beds should be planted at the correct espacement. Where large seedlings are left, as being unsuitable for planting out, they should be thinned to the approximate espacement, if too dense, and supplemented by planting, if too few. It has been prescribed that stacking sites should not be located within regeneration areas. Where this is absolutely unavoidable, such sites must be planted in the succeeding year.

(*b*) *Sowing.*—With a view to the establishment of teak crops in time to take full advantage of the good growing weather which is common in June (during breaks in the rain), direct sowing shall be undertaken, on an experimental scale in the first instance. If results are better than those obtained from planting, sowing will become the main method If definitely less successful than planting, the experiment will be discontinued. Ten to 15 acres a year will be tried, at first. The soil will be loosened with pick-axes, as described above. Seeds will be soaked in water for 48 hours before sowing. About six seeds shall be sown at each stake, in the middle of April, and lightly covered with earth. To prevent them being washed out by rain, a *slight* depression should be made. Supplementary planting will not be undertaken till the second burst of the monsoon (which will probably be some time

between the middle and end of June). The stocking shall then be completed by planting seedlings at all stakes where germination has failed, or where seedlings have died. Surplus seedlings, from stakes where there are two or more, will be utilized as far as possible, and will be supplemental by nursery transplants if necessary.

The above is the main method of sowing, but two modifications are suggested for trial, on a small scale at first, and for general adoption, later, if desirable. To hasten germination, a dump of seed, 4 to 6 inches deep, should be put out on well-drained ground (a rock is the best), covered with straw and copiously watered daily, or twice a day. As soon as signs of germination are noticed (probably within 5 or 6 days), all the seeds should be sown at stakes, as described above. It will probably be found desirable to turn the seeds in the dump each day, and there is no danger of breaking the radicles in doing so, for the seeds are to be sown as soon as germination commences. The best time for this artificial weathering will probably be about 10th April. The second suggestion is for providing cheap transplants for filling blanks. Small dumps of seed should be put out, in different parts of the area, after soaking in cold water as before, in the middle of April. Germinating seeds and small seedlings will be taken from them, as required, to replace casualties.

(*c*) *Coppice regeneration.*—Reference has been made, in the paragraphs dealing with choice of species and silvicultural system (paragraphs 226 and 227), to certain areas where coppice regeneration is to be tried. In order to investigate, as early as possible, an alternative treatment to re-planting with teak for the poorest teak localities, two areas are prescribed for coppice felling in the first year of the period. All teak trees shall be felled, and mature trees of other species (if any) may be felled as well. The stools shall be slightly raised in the centre and flush with the ground on the perimeter, and shall be trimmed. Whether the felling debris should be burnt or not is left to the discretion of the local officers. The best time for felling has to be decided. It will probably be about the month of March. Two of the best shoots at each stool should be favoured from the first, cutting surplus shoots. It will probably be desirable to reduce the number to one, within the first year, but this question, also, is left for further consideration. Poles and saplings of species other than teak shall not be cut, except where they are hampering the development of the teak coppice. Even then, if such poles are of very valuable species such as rosewood, they should be favoured. Subsequent treatment will be determined by the management, and carried out as necessary. The areas will, however, be put down in the statements of second year tending and of thinnings, along with the areas regenerated in the usual way, when climber-cutting, freeing coppiceshoots, etc., should be undertaken. The most that can be expected, of areas treated in this way, is a modest return from teak coppice, while establishing shade conditions suitable for the introduction of some other species.

(*d*) *Change of species by natural means.*—In very poor teak crops, a few small areas have been chosen where the natural understorey (chiefly Xylia xylocarpa) is almost sufficient to give a complete even-aged crop, after the removal of the teak. All teak trees shall be felled in such areas, and such improvement felling as seems necessary shall be done amongst the underwood. (This will probably be confined to the removal of a few saleable, deformed Xylia trees which are hampering the development of good poles.) Any trees of useful species, which are broken in the course of final felling, shall be cut at ground level, and extracted if saleable. If any trees are left too open by the removal of the teak, the teak stumps shall be trimmed, and coppice shoots tended, as in coppice regeneration. This form of treatment is experimental, but is almost certain to succeed. It may be found desirable to extend it in future, in the event of the failure of second rotation teak crops on laterite soils.

239. *Weeding in year of formation.*—A single weeding during the monsoon is usually all that is required, and it is best done as soon as the weeds show signs of flowering some time in July. The first weeding shall be in strips 4 feet wide, i.e., 2 feet on each side of the rows of teak. On the intermediate strips the weeds shall be cut, and the weeds from the cleaned strips shall be piled on top. The only advantage of deep digging, at this time, is that the entire roots of the weeds can be removed. The loosened soil is quickly beaten hard by the rain, and growth is

almost negligible till the monsoon abates. Therefore, unless a much cheaper method of deep digging than by using mamotties can be devised, in the first weeding the weeds shall be removed by shallow digging which only cuts the roots of much of the weed growth. (The money saved can be well spent on digging at periods of active growth, and it has been found that this modified form of weeding is quite sufficient to keep weeds in check till the end of the monsoon.) It is undesirable, however, to scrape a lot of the surface soil into the intermediate strips, so the loose earth shall be shaken on to the cleaned strips, before the weeds are laid in lines. On sloping ground the strips should run roughly parallel to the contours. The second weeding shall be undertaken as soon as the monsoon ends, usually late in August or early in September. *It shall include soil æration over the whole area.* This innovation is made with the object of stimulating the early growth of second rotation teak. In that it involves no damage to plants, and goes deeper, hand-digging would be preferable to ploughing. But unless hand implements can be devised which will compare favourably with ploughs in the matter of expense, the work shall be done by ploughing. The soil shall be thoroughly broken up, by ploughing and cross ploughing, between the rows, until all soil except that closest to the teak has been turned over. The writer has seen ploughing done only in 'ponam' areas, so he cannot specify what hand-weeding should accompany the ploughing. It is likely that some grass knifing will be required in advance of the ploughing, and it seems certain that the weeds nearest to the teak must be uprooted by hand. All weeds shall be collected and laid in strips between the rows, after shaking the loose soil from their roots. Ploughing must be done with as little damage to the plants as possible. All damaged stems shall be cut back, at ground level, immediately after ploughing. Ploughing is impracticable on the steeper slopes. Here the soil æration must be done by hand-digging, with such tools as combine cheapness with efficiency. Weeds shall be laid roughly parallel to the contours on sloping ground. These prescriptions for the second weeding are subject to modification in the light of practical experience, but the underlying principle (namely, that all or most of the soil in the regeneration area must be tilled) is to be observed, remembering that the stimulation of plant growth will probably render a third weeding unnecessary. . Provided that formation is done early and well, it is believed that such will usually be the case in all except the poorest areas. No further general weeding is prescribed, but it is laid down that a third weeding shall be carried out to such extent and in such manner as is necessary, before the 20th of December.* The interpretation of this prescription is left to the District Forest Officer. *In all weeding operations, special efforts must be made to retain as much as possible of the natural regeneration and regrowth of miscellaneous tree species*, except where they threaten to retard the growth of the teak. Where it is necessary to check such growth, it should be cut (not uprooted) so that it may grow again, when the teak is out of danger. Bamboos are rare in the areas now prescribed for regeneration. Regrowth of bamboo cannot, however, be tolerated in a young teak plantation. New shoots shall be cut as soon as they appear, and the clumps will eventually be killed in this way. In the few areas where coppice regeneration is prescribed, the necessary tending and thinning of coppice shoots shall be undertaken while weeding the neighbouring planted areas. It is hardly necessary to add that close supervision of weeding is essential.

240. *Artificial introduction of a ground cover crop.*—After the weedings of the first year, it has been observed that the soil quickly becomes very hard again, and it is usual for a thick carpet of grass to spring up. Nothing could be much less favourable to the growth of young teak. Since the growth of second rotation crops has usually been so poor, it has been decided to undertake special tending operations which are not extended to natural forest clearings. The first of these special operations, namely, ploughing or other soil æration, has already been prescribed. To keep the soil loose thereafter, and to prevent the growth of grass and other weeds which are so prejudicial to the young teak, it seems desirable to introduce some subsidiary species which will quickly cover the ground between the teak rows. The retention of adventitious growth of tree species has already been mentioned, but such growth will usually be insufficient. The choice of the subsidiary species is a matter for experiment both by the District Forest Officer and the Forest Research Officer. The writer knows of one species which is suitable, for he has seen it used

under young teak in Travancore Government plantations, and as a cover crop in new rubber clearings near Nilambur. Tephrosia candida is a bushy leguminous shrub, which grows to a height of 8 or 9 feet. Pruned back, as required, to a height of about 3 feet, it becomes more bushy, and the prunings (together with normal leaf shedding) make a nice leaf litter, and manure the soil to some extent. Once established, it keeps down even the worst grass. As regards the fixation of free nitrogen by the roots of legumes of this kind, the present-day theory is that the benefit derived by the soil in this way is slight, although there certainly is some benefit. As far as the writer can foresee at present, the main objection to the introduction of Tephrosia candida is that it usually commences to die out in its third year. But by that time the teak canopy should be commencing to close up. By regular pruning of the shrub, it should be possible to prevent the suppression of adventitious tree species. As a tentative prescription it is therefore laid down that Tephrosia candida shall be introduced in young teak plantations to such extent as is found practicable and desirable. (For example, some areas may have such a good burn that weed growth may not be a factor to be feared. Again, a thorough ploughing may be found to be sufficient, when coupled with a good distribution of tree species of natural origin, and supplemented by the artificial introduction of others. And other conditions, as yet unforeseen, may arise to influence the management in the direction of some more appropriate treatment.) The manner of introducing the shrub cannot be prescribed. The obvious time to sow it would be after the ploughing. But the uncertainty of the north-east monsoon may be found to be a prohibitive factor. The alternative is to sow the seed during the showers which precede the south-west monsoon of the year after formation, i.e., after the second-year weeding. Seeds sown in two lines between the teak, at the rate of 4 lbs. (or less) to the acre should be adequate. Rows or strips of Tephrosia candida should run roughly parallel to the contours, on slopes where wash is feared. Some weeding may be required to assist the shrub to establish itself. The times for pruning the shrub (at about 3 feet from ground level) are October-November and April-May.

The introduction of such species as Hydnocarpus Wightiana, Macaranga Roxburghii and Grewia nudiflora, should be tried, experimentally, in the monsoon of the second year. An underwood of any of these species, if it could be raised cheaply, might easily be preferable to Tephrosia candida.

241 *Pruning.*—In April or May of the second year, all forked stems and stout side branches shall be carefully pruned, absolutely flush with the main stem, and without tearing the bark surrounding the cut surface. Sharp knives must be used. Plants which will require pruning are exceptional and not the rule, and are as described above. (This prescription of pruning does *not* include licence to strip practically all the leaves off undivided stems, as has been done in at least one year recently.) Damaged stems (e.g., such as are sometimes broken by monkeys) shall, at the same time, be cut back, with a clean cut, at ground level. If any regrowth or regeneration of tree species or woody shrubs are found interfering with the young teak, they shall be cut in the course of pruning.

242. *Second-year weeding.*—In a really good teak plantation of the Plantation Working Circle, a second-year weeding, as such, is not required. But in order to continue the process of soil æration, with a view to stimulating the early growth, a thorough soil-working in the second year is undoubtedly desirable, and it is believed that the end of April or the beginning of May is the very best time, whether leguminous cover crops (or tree species for an underwood) are to be introduced or not. The growing season, from the commencement of the early showers until the period of heaviest rain, is very important. Mr. Bourne prescribed the second-year weeding in July. A weeding at this time would probably remove the weeds before they flower, but would do practically nothing towards stimulating the growth of the teak. The drawback to the early weeding and æration which the writer advocates is the question of cost. But he believes that this weeding can be achieved at a reasonable cost by undertaking it soon after a burst of heavy rain, and by using a tool which is more suitable than the old-fashioned mamotty. It is therefore prescribed that weeds shall be uprooted, by digging, as soon as a really heavy shower has fallen, either in April or early May. The weeding shall be done in

4-foot strips (2 feet on either side of the teak rows) and roughly parallel to the contours on slopes where wash is to be feared. The soil shall be shaken from their roots, and the weeds shall be laid on the intermediate strips, as described for first-year weeding. If seeds of Tephrosia candida (or seeds or plants of any tree species) are to be introduced at this time, they can then be introduced in two lines along either side of the strip of uprooted weeds. Provided a full stocking of teak is obtained in the first year (as should be the case) there will be no necessity to replace casualties in the second year. In fact, the replacement of scattered casualties with teak, after the year of formation, is a waste of money, for the new plants stand no chance against their year-old neighbours in a reasonably good plantation. If small blanks have occurred, by reason of flooding or swampiness in the first year, they should be re-stocked with teak and Terminalia tomentosa at each stake, and the best specimen favoured. Small blanks which result from other causes shall be re-stocked with teak. Finally, it is left to the discretion of the management to replace occasional casualties by planting a species like Xylia xylocarpa, remembering that a new teak plant will never overtake its neighbours, and that the introduction of a small percentage of a species which will survive below the teak canopy, will help towards establishing an underwood. In a reasonably good plantation no further weeding should be required, but if there are any plants below two feet in height at the end of the second monsoon, they shall be weeded in circles of two feet radius with the plant as centre. In the second-year weeding, as in the first, natural tree seedlings and coppice shoots shall be preserved, provided they are not hampering the growth of the teak. Climbers, if any, shall be cut in the course of the weeding. Bamboo shoots shall be cut as before, and any broken teak stems shall be cut back. In areas where teak regeneration by coppice is in progress, such freeing and thinning out of coppice shoots as is necessary, shall be undertaken in the second year.

243. *Exclusion of cattle.*—As has been remarked in Part I, cattle are a real scourge in the young plantations of the second rotation. Much of the advantage to be derived from special tending will be lost, if cattle are allowed to roam the plantations at will. They must be kept out at all costs, and if the system of impounding them, in special pounds near the areas, proves ineffective, the cost of fencing the regeneration areas must not be shirked, regrettable though it be in reserves nominally closed to all grazing !

244. *Thinning.*—The writer finds it impossible to improve upon Mr. Bourne's rendering of the theory of thinning in pure teak woods, so it may be quoted :— " Experience has shown that in the tending of teak woods, radical modifications of the principles of thinning as applied to species cultivated in temperate climates are essential. In the first place, in good teak areas not more than 30 to 40 trees, with reasonable crown development, can stand per acre at 70 years of age. For the attainment of maximum quality increment per tree, and maximum volume increment per acre, it is essential that the espacement of the trees of the final crop should be approximately equal, while each tree, at the same time, should be of a dominant character. In the second place, the teak tree is so fast grown in early youth, and the process of domination and suppression is then so rapid that the final crop must be composed of trees which were dominant from early age. Considering the small number of stems in the final crop, it is, therefore, essential that the trees in final crop espacement should be dominant in early youth. This statement should be clear if expressed in another way. With 34 trees in the final crop, the espacement, in squares, is 36 feet. With planting 6 feet by 6 feet, or 1,210 to the acre, the distance between dominant trees at ten years of age, in an unthinned wood, is as often as not 12 feet. As often as not, again, the tree in final crop espacement stands between them, already suppressed. The dominant trees have to be retained and one of the two at a later date removed. With the result that the final crop espacement will often vary, between 30 and 42 feet, or 48 and 25 trees per acre. The wood in some portions is then too open and in others too dense, with consequent serious domination and loss of total volume or average quality-increment. The sole remedy is to ensure proper espacement of dominant trees from the very start. The management must interfere before natural selection has been carried too far. Thinnings must be carried out before domination becomes serious and every tree, if left standing, is still able to

respond. If such even-spaced woods are then thinned with one object—provision of even growing space to each tree—the result will be removal of 50 or 75 per cent of the crop." So much for the theory, now for the practice. Practically none of the first rotation plantations has been thinned correctly from the start, so the ideal espacement will not be found. In consequence of the postponement of the early thinnings in most cases, the crown development is less than the ideal. The removal of as much as 50 per cent of the crop at each thinning is generally undesirable. Thinning is a science in itself, and it cannot be learnt from a book, unless accompanied by practical personal experience. The following hints may be taken as a general guide. Thinnings should be as heavy as possible, the limiting factor being the capacity of the canopy to close up. In young woods and in good localities, thinning should be much heavier than in older woods and in poor localities. It has proved to be a mistake to conduct heavy final thinnings in the oldest plantations, and this mistake must not be repeated. The thinnings prescribed in the plantations of 1886, 1887, 1888, 1889 and 1890 (or at any rate in the better parts of these plantations) will probably be the final thinnings, and should be conducted with great care. Excessive opening of the canopy in the plantations of 1891 to 1894 must also be guarded against, except in such parts as are obviously able to respond. In good second rotation plantations, Mr. Bourne's theory of thinnings can be practised from the start. Suppressed trees which are unsaleable should not be felled, and the understorey of miscellaneous species must be preserved. When it is necessary to relieve the teak from embarrassment by a tree of inferior species, the latter shall be cut (not girdled) to enable it to produce coppice shoots which will take their place in the understorey. A very poor teak pole is not to be preferred to a really good pole of such species as rosewood, Terminalia tomentosa or Terminalia paniculata, if there is a question of sacrificing one or the other. In thinning compartments which contain permanent sample plots, the latter must be excluded. (They are thinned at each re-measurement by the measuring officers.) Dead saleable trees, standing or fallen, must invariably be removed in the thinnings. The same applies to top-broken trees, including such as are accidentally broken in the course of thinning. Each wood should be thinned as soon as serious domination commences. It is impossible to make a really accurate estimate of the requirements of each wood for ten years ahead. The writer has estimated the years of thinning to the best of his ability, and believes that the management will not go far wrong in following the programme given in the tabular statement of thinnings. The programme should, however, be modified, under proper sanction, when the condition of the different woods demands such a course. It is anticipated that modifications may be particularly necessary in the case of second rotation crops. It is extremely difficult to prescribe the years for thinning the poorest of them, especially as it may be found desirable to cut them back, in the event of the Forest Research Officer's work of this nature being successful, in his plots in the 1919 and 1920 plantations of Elenjeri. It is also difficult to estimate the effect of the special tending prescribed for the plantations of the future, but it is assumed that this tending will produce good growth, so the plantations are prescribed for their first thinning at the age of five years. If the thinning is executed in the beginning of the year for which it is prescribed, these woods will be exactly five years old. If done at the end of the year they will be almost six years old, so that a certain amount of elasticity is allowed, without actually altering the year of thinning, by conducting the operation at the beginning, in the middle, or at the end of the year. Where failed areas, retained in the Teak Felling Series, are included in the programme of thinnings, they shall be thinned so as to favour the best trees of valuable species, whether that species be teak or another. The District Forest Officer should personally mark as much of the thinnings as possible, and, until there are extensive new plantations in the Conversion Working Circle, 25 per cent of the marking should be his annual minimum. He should confine his personal marking chiefly to the younger plantations, and to the better localities, and he should educate his assistant and as many rangers as possible, in correct thinning practice. Marking should be done with a 'risser' as at present, and the trees marked must be counted before felling, as a check. The marked trees must be felled with the least possible damage to the trees which are left. The other rules prescribed for the conduct of final fellings, and recording of yield, shall be followed, except that the numbers of standing trees need

not be chiselled on the tree before felling, nor on the stump after felling. It will usually be sufficient if the stump is hammer-marked. The season for felling depends largely on the availability of labour. It must be remembered, however, that poles for sale should be as fresh as possible, and they should not be felled long before the floating season.

245. *Climber cutting, Loranthus clearing, bamboo cutting and harvesting dead trees.*—In the year in which a plantation is thinned, climbers shall be cut on the trees that are left. Branches parasitised by Loranthus shall also be cut. These branches may be collected and burnt at the discretion of the District Forest Officer, but it is believed that burning is unnecessary. (This, however, is a matter for further study, since it may be found that the Loranthus can live on the severed branch sufficiently long for its fruits to ripen. The species is spread by birds which eat the fruit). In plantations which are past the age for thinning, Loranthus and climber cutting is prescribed, as a special operation, at such intervals as appear to be suitable. In these cases, dead trees (whether standing or fallen) and top-broken trees shall be harvested at the same time, unless they are likely to remain sound until the time for felling, or for further tending operations. In a few instances, in plantations not due for thinning for some years, but in which climbers, etc., are, or are likely to become very bad, intermediate climber and Loranthus cutting operations are prescribed. Finally, it is prescribed that the District Forest Officer shall examine the second rotation plantations every year, and shall undertake climber-cutting (or other suitable tending) in the following year, if he finds it necessary. (In the poorest of the second rotation crops it may even be found advisable to execute thinnings, as required, at this time.) In all the above cases, bamboos found interfering with, or threatening the teak, shall be cut. In case the programme of such subsidiary tending, as hereafter tabulated, is found to be insufficient to cope with all or any of the above injurious influences, the District Forest Officer must undertake such intermediate operations as are necessary.

246. *Underwoods.*—In Part I a description has been given of the unsatisfactory situation, as regards underwoods, in the teak plantations. Recent experience at Nilambur has convinced the writer that the species artificially introduced, up to the present, cannot form a satistactory underwood until they commence to regenerate themselves, unless the management is prepared to spend at least as much on artificial underwoods as in forming teak plantations. In most of the plantations there appears to be only one practical solution of the problem, and that is to encourage the existing saplings and regeneration of all tree species, and to introduce an evergreen species in small areas, in favourable localities, with the object of raising seed-bearers which will produce the underwood of the future. This treatment can suitably be applied to most of the plantations, but there are a few compartments (notably in Chatomborai, Walluvasseri and Pannengode) which fall due for final felling in the period commencing in 1938, and which contain large areas where the canopy is open and where the forest floor is a mass of coarse grass. It is believed that this grass will be a serious embarrassment when the time comes for regeneration, especially as there is practically no material to give a burn in such areas. It is therefore desirable to introduce a species which will kill off the grass, protect the soil, and eventually provide some material for burning. For this purpose, bamboo is a suitable species, and can be raised cheaply by sowing. It will therefore be introduced in all grassy areas in plantation 1872 of Chatomborai. In order to cover the ground as quickly as possible, the espacement should be not greater than 12′ × 12′ A double handful of seed should be scattered round each stake without disturbing the soil. Sowing should be done in the showers which precede the monsoon, or at the very beginning of the monsoon The plantations in Pannengode and Walluvasseri, to which reference has been made, are due for felling too early to allow of the adoption of the above treatment. A faster growing underwood is required. Macaranga Roxburghii is a suitable species. So, also, is Vitex Negundo, provided it will succeed under the teak. Both species should be tried experimentally, on a small area, in 1928. Cuttings of Vitex Negundo should be planted about 12 feet apart. Macaranga Roxburghii may be sown at stakes about 9 feet apart, and if germination fails, seedlings should be planted. (Natural forest seedlings are often procurable in large

quantities near a mother tree.) The remainder of the bad grassy areas in these old plantations (they amount to less than 20 acres) will be treated in the next year, in such manner as the experiments indicate.

The general method of tackling the underwood question will now be considered. The treatment to be adopted in second rotation plantations has been prescribed above, under formation and weeding. In the first rotation plantations, it is desirable to reduce artificial operations to a minimum, from the points of view of cost, labour, supervision, and concentration of work. Therefore, wherever the natural understorey of saplings and regeneration of tree species (and of bamboo in older crops on good localities) appears to stand a chance of becoming sufficient, no assistance is prescribed. In other areas it is prescribed that a gang of coolies, under close responsible supervision, will go through each compartment carefully, and free the heads of all seedlings, coppice shoots, and root suckers of every tree species, by cutting creepers, and shrubby undergrowth. (Grass, provided it is not unduly tall and thick; is unlikely to prevent miscellaneous species growing up.) No adventitious growth, in any of the plantations, may be cut, unless it is hampering the development of the teak. Government elephants must be kept out of the plantations. For the establishment of small patches of an evergreen species in favourable localities throughout the plantations, Hopea parviflora is chosen. Its winged seeds travel to a considerable distance, and its natural regeneration has proved to be a good underwood in the few areas where it is found. The species needs a considerable amount of shade in early youth. Suitable shade conditions can be found, in small areas, on or near almost every hill top in the teak plantations. In the miscellaneous felling series, suitable shade is often found in areas of considerable size where a natural crop of Xylia xylocarpa has replaced the planted teak. In the latter case the introduction of Hopea will be prescribed as part of the treatment of this felling series. In the case of the teak felling series, it is prescribed that not less than 200 seedlings of Hopea shall be raised in a suitable area (or areas) on or close to each of the chosen hill-tops. One-year old transplants shall be used where possible. Three years will be allowed for the establishment of each such centre, and it is essential that it should be fully stocked within that time. The subsequent tending of the Hopea is left to the discretion of the management, as the writer cannot say, at present, how soon it will be necessary to open the canopy, or in what years climber-cutting may be required. It is essential, however, to keep fire out, and special care will be needed when the Hopea patches are near areas which are being cleared for teak planting. The advantages of the successful establishment of these centres will be twofold. Their natural regeneration should give a good underwood in the future. They should also provide the management with a cheap means of changing the species, and such a course is almost certain to be desirable in many of the poorer teak areas adjacent to the Hopea centres. A tabular statement has been prepared, giving the years, and the compartments, in which the various operations are to be undertaken. As regards the active encouragement of natural adventitious growth, the programme may be modified, if necessary, by excluding areas which are found, a few years hence, to require no assistance, and by adding others of whose prospects the writer has been too optimistic. In deciding to exclude any areas, it must be remembered that an undergrowth of shrubs such as Helicteres Isora, Calycopteris floribunda, etc., though it protects the soil to a reasonable extent, is *not an underwood* and is not, in itself, sufficient.

247. *Reclamation of second-rotation failed areas in good teak localities.*—There are 99·1 acres in good localities in second-rotation plantations, where the teak has failed, either owing to destruction by flood or to faulty methods of regeneration (e.g., the 1926 "ponam" plantations). Subsequent efforts to re-stock some of these areas, both with teak and with other species, have been uniformly unsuccessful. Being very close to the main river and to the Nilambur railway, the potential value of these areas is enormous, and it is advisable to re-afforest them as soon as possible. Since failure has attended the efforts made to introduce species other than teak, it is necessary to restore the soil before further regeneration of timber species is attempted, and since such restoration is required, the aim must be to make these areas fit for teak, as being the most valuable species. For this restoration of the soil,

bamboo is the only species which the writer can confidently recommend, without experiment. Some of these areas, however, are too narrow to make bamboo a suitable choice, for its shade would spoil the adjacent plantations of young teak. Another objection to bamboo is that it will probably take at least twenty years to restore the soil, whereas some other species may achieve this object in a much shorter time. In the circumstances, the best thing the writer can recommend is to introduce bamboo in most of the larger areas; to introduce fast-growing shrubs, experimentally, in most of the smaller areas; and to attempt the re-introduction of teak, a few years hence, in some of the areas which have already a dense natural soil-covering, without any preliminary treatment. In introducing fast-growing shrubs, the object must be to establish a thick cover crop as quickly as possible. Tephrosia candida and Vitex Negundo should be tried, the former by sowing, in such way as the management finds most suitable, and the latter by planting cuttings, about 12 feet apart, early in the monsoon. The Tephrosia candida should be pruned as required. Since it usually commences to die out in its third year, it should be cut and burnt when it shows signs of dying out, and teak should be re-introduced. Vitex Negundo grows readily from cuttings, and reproduces itself profusely, both from seed and by root suckers, when two years old or less. The first attempt at re-planting teak should be made about six years after the introduction of Vitex Negundo.

Bamboo should be sown at stakes 20 feet apart. Preparation of the soil is undesirable, as this attracts rats and birds to the seed. A double handful of seed should be scattered round each stake. If germination is found to be unsatisfactory, sowing should be repeated in the next year. If either Tephrosia candida or Vitex Negundo is found to make the early re-introduction of teak possible, the successful species may then be used in the areas sown with bamboo, in order to save time, and avoid waiting for the bamboo to grow up. In a few small areas where there is a dense soil-covering of Mimosa pudica (which *should* be a soil-improver) an attempt should be made to re-introduce teak a few years hence. The whole of one compartment has a good soil-covering, chiefly of Desmodium species, with some Lantana and Calycopteris floribunda, and scattered clumps of coppice shoots of teak, Terminalias, Cleistanthus collinus, etc. This area will be left as it is until, in the opinion of the Conservator, the ground is fit for replanting, when it should be re-cleared and planted with teak. The localities for the different methods of treatment will be found in the tabulated statement of operations. As regards future treatment, the management must be guided by the success or otherwise of these prescriptions, bearing in mind that it is essential to re-establish good teak crops on these areas in the shortest possible time.

248. *Tabular statements of operations.*—The next six paragraphs contain the annual programme of operations in the teak felling series. The tables should be read in connexion with the detailed working-plan prescriptions, as follows:—

Paragraph 249	...	"Final felling" with paragraphs 230 to 232 above.
" 250	...	"Formation" with paragraphs 233 to 243 above.
" 251	...	"Thinning" with paragraph 244 above.
" 252	...	"Subsidiary tending" with paragraph 245 above.
" 253	...	"Formation and tending of underwoods" with paragraph 246 above.
" 254	...	"Reclamation of failed areas for teak" with paragraph 247 above.

Teak Felling Series.

Plan of final felling.

249—

Year of felling, name of block and year of plantation. (1)	Compartment number. (2)	Sub-compartment letter. (3)	Total area. (4)	Area under teak reduced to I quality. (5)	Stemwood volume of real growing stock in March 1928. (6)	Real stemwood volume increment from 1928 to year of felling. (7)	Real stemwood volume of the final yield. (8)	Remarks. (9)
1928-29.			ACS.	ACS.	C. FT.	C. FT.	C. FT.	
Edacode 1893	57	*a, b.*	14·0	3·95	5,426	197	5,623	Compartment 57 *a*, *b* and 5 acres of 41 *b* to be felled for coppice regeneration.
Do. 1849	81	*a, b, c, d.*	24·1	17·91	47,351	348	47,699	
Elenjeri . .. 1858	41	*a, b.*	26·1	15 99	39,159	406	39,565	
Ambalakandy .. 1844	243	*a.*	0 8	0·60	1,809	10	1,819	
Chaliyapuram .. 1844	244	*a, b.*	9·3	5·83	13,759	81	13,840	
Ramalur 1846	26	*b.*	0·8	..	..	..	..	
Total ..			75·1	44·28	107,504	1,042	108,546	
1929-30.								
Elenjeri 1858	42	*a, b.*	12·9	9·19	25,046	546	25,592	
Do. 1859	43	*a, b.*	14·8	8 95	23,280	505	23,785	
Do. 1859	44	*a, b, c.*	20·7	15·37	38,832	889	39,721	
Karumpoya .. 1908	324	*d, e, f.*	15 9	6 42	5,338	660	5,998	
Total ..			64·3	39·93	92,496	2,600	95,096	
1930-31.								
Pannengode .. 1854	119	*a, b.*	8·5	7·94	17,052	500	17,552	In sub-compartments 121 *d* and 122 *c* only the teak is to be felled; Xylia under-wood to be left.
Do. .. 1854	121	*a, b, c, d.*	13·2	7·21	16,017	343	16,360	
Do. .. 1854	122	*a, b, c.*	18·9	12·86	31,693	886	32,579	
Karumpoya .. 1908	321	*d, e.*	21·0	14·18	7,608	1,416	9,024	
Total ..			61·6	42·19	72,370	3,145	75,515	
1931-32.								
Pannengode .. 1854	123	*a, b.*	18·2	10·89	25,881	941	26,822	
Do. .. 1856	128	*a, b, c, d.*	21·0	12·88	30,867	1,228	32,095	
Do. .. 1856	129	*a, b, c*	21·3	15·67	39,404	1,604	41,008	
Total ..			60 5	39·39	96,152	3,773	99,925	
1932-33.								
Pannengode .. 1855	124	*a.*	16·2	7 90	14,852	648	15,500	Compartment 124 *a*, 125 *a* and 126 *a* to be felled for coppice regeneration.
Do. .. 1855	125	*a.*	11·3	5·51	12,086	525	12,611	
Do. .. 1855	126	*a.*	6·7	3·27	7,166	311	7,477	
Do. .. 1856	127	*a, b.*	20·5	10·28	25,840	1,210	27,050	
Moolathamanna .. 1853	21	*a, b.*	5·5	2·89	7,541	315	7,856	
Do. .. 1853	22	*a, b.*	6·2	3 49	8,873	326	9,199	
Aravallikava .. 1852	8	*a, b.*	6·5	4 75	13,651	592	14,243	
Do. .. 1853	4	*a, b, c.*	10·2	5·01	12,755	522	13,277	
Total ..			83·1	43·10	102,764	4,449	107,213	
1933-34.								
Aravallikava .. 1852	7	*a, b, c.*	32·4	20·11	55,644	2,833	58,477	
Edacode 1860	89	*a, b, c, d.*	20·3	13·31	31,036	2,158	33,194	
Do. 1860	90	*a, b.*	15·3	7·37	13,336	1,142	14,478	
Total ..			68·0	40 79	100,016	6,133	106,149	
1934-35.								
Edacode 1861	91	*a.*	7·7	3·76	7,869	616	8,485	
Do. 1861	92	*a, b, c.*	8·6	5·28	12,776	1,062	13,838	
Do. 1861	93	*a, b, c.*	13 0	8·33	19,187	1,606	20,793	
Do. 1861	94	*a, b.*	5·4	2·84	6,305	508	6,813	
Do. 1861	95	*a, b, c, d.*	16·6	9·60	20,713	1,720	22,433	
Do. 1861	96	*a, b, c, d.*	19·4	8·25	14,262	1,684	15,946	
Do. 1862	98	*a, b, c.*	7·7	4·00	7,428	874	8,302	
Total ..			78·4	42·06	88,540	8,070	96,610	
1935-36.								
Edacode 1862	97	*a, b, c, d, e.*	19·0	12·38	29,514	3,001	32,515	Sub-compartment 63 *c* to be felled for coppice regeneration.
Do. 1862	99	*a, b, c, d.*	19·2	13 96	32,723	3,351	36,074	
Do. 1857	63	*a, b, c.*	21·1	8·99	19,669	1,488	21,157	
Do. 1857	64	*a, b, c.*	11·9	7·28	16,196	1,320	17,516	
Total ..			71·2	42·61	98,102	9,160	107,262	

Teak Felling Series—cont.

Plan of final felling—*cont.*

Year of felling, name of block and year of plantation. (1)	Compartment number. (2)	Sub-compartment letter. (3)	Total area. (4)	Area under teak reduced to I quality. (5)	Stemwood volume of real growing stock in March 1928. (6)	Real stemwood volume increment from 1928 to year of felling. (7)	Real stemwood volume of the final yield. (8)	Remarks. (9)
			ACS.	ACS.	C.FT.	C.FT.	C.FT.	
1936-37.								
Pannengode .. 1864	145	*a, b.*	12·4	6·31	13,103	1,499	14,602	
Do. .. 1864	146	*a, b, c.*	23·5	18·20	38,969	4,968	43,937	
Walluvasseri .. 1864	158	*a, b, c.*	20·7	14·53	31,249	3,883	35,132	
Total ..			56·6	39·04	83,321	10,350	93,671	
1937-38.								
Walluvasseri .. 1864	156	*a, b, c.*	11·7	9·00	21,645	3,071	24,716	In sub-compartment 246 *c* only teak and other saleable trees to be felled. (The area is unfit for regeneration.)
Do. .. 1864	157	*a, b, c.*	31·7	20·70	45,818	6,283	52,101	
Puthalath and Chittarikal .. 1844	245	*a, b, c, d*	7·4	3·35	9,804	580	10,384	
Pozhayi-Mangalasseri 1844	246	*a, b, c.*	18·0	8·30	20,005	1,180	21,185	
Total ..			68·8	41·35	97,272	11,114	108,386	
Grand totals for period 1928-29 to 1937-38 ..			687·6	414·74	938,537	59,836	998,373	

NOTE.—(1) Unless otherwise stated in the remarks column, clear felling, followed by regeneration with teak, is at present contemplated in all compartments and sub-compartments.

(2) All volume and increment figures—columns (6), (7), and (8)—are given in terms of volume by the quarter-girth method of increment.

Teak Felling Series.

250— Plan of formation.

Year.	Nature of operation.	Compartments and sub-compartments.	Area in acres.	Remarks.
1928-29	Formation and first year tending.	77 *a, b*; 83 *a, b, c*; 88 *a, b, c*. 20 *a, b*; 27 *a, b*; 28 *a*; 29 *a*; 38 *a*; 39 *a*; 40 *a*; 61 *a*; 70 *a*; 82 *a*; 86 *a*; 87 *a*.	63·6 166·5	Plantations of 1927, so poorly stocked as to need almost complete reformation.
	Second year tending ..	74 *a*; 26 *a*	13·8	Plantations of 1926.
1929-30	Formation and first year tending.	57 *a, b*; 81 *a, b, c, d*; 41 *a, b*; 243 *a*; 244 *a, b*; 26 *b*.	75·1	Coppice regeneration in 57 *a, b* and 5 acres of 41 *b*.
	Second year tending ..	77 *a, b*; 83 *a, b, c*; 88 *a, b, c*; 20 *a, b*; 27 *a, b*; 28 *a*; 29 *a*; 38 *a*; 39 *a*; 40 *a*; 61 *a*; 70 *a*; 82 *a*; 86 *a*; 87 *a*.	230·1	Compartments 77, 83 and 88 must be tended in accordance with prescriptions. The management will decide whether the others merit such expensive treatment.
1930-31	Formation and first year tending.	42 *a, b*; 43 *a, b*; 44 *a, b, c*; 324 *d, e, f*.	64·3	....
	Second year tending ..	57 *a, b*; 81 *a, b, c, d*; 41 *a, b*; 243 *a*; 244 *a, b*; 26 *b*.	75·1	....
1931-32	Formation and first year tending.	119 *a, b*; 121 *a, b, c, d*; 122 *a, b, c*; 321 *d, e*.	61·6	In 121 *d* and 122 *c*, the Teak is to be felled and Xylia xylocarpa left to form the new crop.
	Second year tending ..	42 *a, b*; 43 *a, b*; 44 *a, b, c*; 324 *d, e, f*.	64·3	....
1932-33	Formation and first year tending.	123 *a, b*; 128 *a, b, c, d*; 129 *a, b, c*.	60·5	....
	Second year tending ..	119 *a, b*; 121 *a, b, c, d*; 122 *a, b, c*; 321 *d, e*.	61·6	....
1933-34	Formation and first year tending.	124 *a*; 125 *a*; 126 *a*; 127 *a, b*; 21 *a, b*; 22 *a, b*; 8 *a, b*; 4 *a, b, c*.	83·1	Coppice regeneration in 124 *a*, 125 *a* and 126 *a*.
	Second year tending ..	123 *a, b*; 128 *a, b, c, d*; 129 *a, b, c*.	60·5	....
1934-35	Formation and first year tending.	7 *a, b, c*; 89 *a, b, c, d*; 90 *a, b*.	68·0	....
	Second year tending ..	124 *a* 125 *a*; 126 *a*; 127 *a, b*; 21 *a, b*; 22 *a, b*; 8 *a, b*; 4 *a, b, c*.	83·1	....
1935-36	Formation and first year tending.	91 *a*; 92 *a, b, c*; 93 *a, b, c*; 94 *a, b*; 95 *a, b, c, d*; 96 *a, b, c, d*; 98 *a, b, c*.	78·4	....
	Second year tending ..	7 *a, b, c*; 89 *a, b, c, d*; 90 *a, b*.	68·0	....
1936-37	Formation and first year tending.	97 *a, b, c, d, e*; 99 *a, b, c, d*; 63 *a, b, c*; 64 *a, b, c*.	71·2	Coppice regeneration in 63 *c*.
	Second year tending ..	91 *a*; 92 *a, b, c*; 93 *a, b, c*; 94 *a, b*; 95 *a, b, c, d*; 96 *a, b, c, d*; 98 *a, b, c*.	78·4	....
1937-38	Formation and first year tending.	145 *a, b*; 146 *a, b, c*; 158 *a, b, c*.	56·6	....
	Second year tending ..	97 *a, b, c, d, e*; 99 *a, b, c, d*; 63 *a, b, c*; 64 *a, b, c*.	71·2	....

251--

Teak Felling Series.

Plan of thinning.

Year of felling.	Name of block and year of plantation.	Compartment number.	Sub-compartment letter.	Area in acres.
1928-29.	Edacode, 1893 ..	52	*a, b, c* ..	17·7
		53	*a, b, c* ..	16·1
		54	*a, b, c, d* ..	10·5
		55	*a, b, c* ..	4·9
		56	*a, b, c, d* ..	13·9
		58	*a, b, c* ..	3·7
		59	*a, b, c* ..	18·5
		60	*a, b* ..	6·5
	Edacode, 1894 ..	45	*a, b, c, d* ..	14·5
		46	*a, b* ..	20·4
		47	*a, b, c* ..	25·4
		48	*a, b, c, d* ..	11·2
		49	*a, b, c, d* ..	13·0
		50	*a, b* ..	21·9
		51	*a, b* ..	7·8
	Karumpoya, 1901 ..	274	*a, b, c, d* ..	18·3
		275	*a, b, c, d* ..	32·5
		276	*a, b, c, d* ..	17·9
		277	*a, b* ..	13·4
		278	*a, b* ..	13·4
		279	*a, b* ..	9·8
		280	*a, b* ..	6·8
		281	*a, b* ..	10·1
	Karumpoya, 1902 ..	310	*a, b, c, d* ..	24·9
		311	*a, b, c, d* ..	23·5
		312	*a, b* ..	6·2
		313	*a, b, c* ..	3·9
		314	*a, b, c, d* ..	15·9
		315	*a, b, c* ..	19·9
		316	*a, b, c* ..	21·6
	Karumpoya, 1911 ..	339	*a, b, c, d* ..	25·6
		341	*a, b, c* ..	16·4
	Karumpoya, 1912 ..	330	*a, b, c, d* ..	8·1
		331	*a, b, c* ..	4·5
		332	*a, b, c, d* ..	26·3
		333	*a, b, c, d* ..	13·7
	Aravallikava 1842—1918 ..	1	*a, b* ..	13·6
	..	2	*a, b* ..	10·7
	Aravallikava 1853—1918 ..	3	*a, b, c* ..	18·4
	Elenjeri 1845—1919 ..	31	*a* ..	16·2
	Elenjeri 1849—1919 ..	37	*a* ..	23·7
	Arevakode 1848—1922 ..	12	*a* ..	6·7
		13	*a* ..	6·8
	..	14	*a* ..	15·3
			Total ..	650·1
1929-30.	Edacode, 1891 ..	100	*a, b, c* ..	13·1
		101	*a, b, c* ..	10·8
		102	*a, b, c, d* ..	10·0
		103	*a, b, c* ..	8·7
		104	*a, b, c* ..	11·9
		105	*a, b, c* ..	14·3
		106	*a, b, c* ..	18·3
		107	*a, b* ..	4·0
	Edacode, 1892 ..	108	*a, b* ..	10.0
		109	*a, b, c* ..	6·9
		110	*a, b* ..	9·8
		111	*a, b* ..	9·3
		112	*a, b, c* ..	7·6
		113	*a, b, c* ..	5·3
		114	*a, b, c* ..	19·5
		115	*a, b, c, d* ..	18·3
		116	*a, b, c* ..	8·0
		117	*a, b* ..	11·0
		118	*a, b, c* ..	17·8
	Pokode, 1889 ..	208	*a, b, c* ..	12·5
		209	*a, b, c* ..	12·4
		210	*a, b, c* ..	8·4
		211	*a, b, c* ..	11·7
		212	*a, b, c* ..	14·1
		213	*a, b, c* ..	11·6
		214	*a, b* ..	8·5
		215	*a, b* ..	16·0
		216	*a, b* ..	6·4

Year of felling.	Name of block and year of plantation.	Compartment number.	Sub-compartment letter.	Area in acres.
1929-30 —*cont*	Karumpoya, 1905 ..	290	*a, b, c* ..	9·8
		291	*a, b, c* ..	7·5
		292	*a, b, c* ..	8·9
		293	*a, b, c* ..	5·1
		294	*a, b* ..	12·2
		295	*a, b* ..	4·5
		296	*a, b* ..	11·4
		298	*a, b, c* ..	19·0
		299	*a, b* ..	6·8
	New Amarampalam, 1905	344	*a* ..	2·3
	Karumpoya, 1904 ..	300	*a, b, c, d* ..	17·9
		301	*a, b, c, d* ..	5·3
		302	*a, b, c* ..	8·5
		303	*a, b, c* ..	12·4
		304	*a, b, c, d* ..	11·0
		305	*a, b, c* ..	16·2
	Karumpoya, 1903 ..	306	*a, b, c, d* ..	5·3
		307	*a, b, c, d* ..	16·1
		308	*a, b, c, d* ..	22·7
		309	*a, b, c* ..	18·8
	Karumpoya, 1907 B.	317	*a, b, c* ..	20·4
		318	*a, b* ..	17·8
		319	*a, b, c* ..	16·5
		320	*a, b* ..	8·1
	Elenjeri 1846—1918 ..	30	*a, b, c* ..	10·8
	Elenjeri 1846—1920 ..	32	*a* ..	13·4
	Elenjeri 1849—1920 ..	34	*a* ..	6·8
		35	*a* ..	9·9
	..	36	*a* ..	7·6
			Total ..	639·5
1930-31.	Pannengode, 1886 ..	133	*a, b, c, d* ..	14·7
		134	*a, b, c, d* ..	10·7
		135	*a, b, c* ..	12·9
		136	*a, b* ..	11·1
		137	*a, b, c* ..	19·1
		138	*a, b* ..	12·6
	Walluvasseri, 1888 ..	147	*a* ..	10·3
		148	*a, b* ..	10·3
		150	*a, b* ..	3·3
		151	*a, b* ..	6·1
		152	*a, b, c* ..	23·6
		153	*a* ..	3·6
		154	*a, b* ..	12·9
		155	*a, b, c* ..	5·8
	Pokode, 1890 ..	217	*a, b* ..	2·7
		218	*a, b* ..	8·2
		219	*a, b, c, d* ..	19·1
		220	*a, b, c, d* ..	16·5
		221	*a, b, c, d, e.*	15·0
	Karumpoya, 1897 ..	252	*a, b* ..	10·1
		253	*a, b, c* ..	16·5
		254	*a, b, c* ..	6·0
		255	*a, b, c* ..	7·6
		256	*a, b* ..	13·5
		257	*a, b* ..	11·1
	Karumpoya, 1906 ..	285	*a, b* ..	5·4
		286	*a, b* ..	25·0
		287	*a, b, c* ..	21·7
		288	*a, b, c* ..	16·2
		289	*a, b, c, d* ..	32·7
	Karumpoya, 1909 ..	325	*a, b, c* ..	42·3
		326	*a, b, c, d* ..	18·9
		327	*a, b, c, d* ..	8·3
		328	*a, b, c* ..	14·0
		329	*a, b, c, d* ..	26·2
	Aravallikava, 1844—1917 ..	5	*a, b* ..	15·9
	Edacode, 1844—1923 ..	65	*a* ..	4·1
	Edacode, 1845—1923 ..	68	*a, b* ..	9·5
	..	69	*a* ..	0·5
			Total ..	524·0

Teak Felling Series—cont.

Plan of thinning—*cont.*

Year of felling.	Name of block and year of plantation.	Compartment number.	Sub-compartment letter.	Area in acres.
1931-32	Pannengode, 1887	139	a, b, c	10·9
		140	a, b, c, d	10·1
		141	a, b, c	14·5
		142	a, b	9 8
		143	a, b	8·0
		144	a, b, c, d	12·5
	Karumpoya, 1898	258	a, b, c	14·5
		259	a, b, c	7·7
		260	a, b, c	8·6
		261	a, b, c	13·5
	Karumpoya, 1899	262	a, b, c	13 8
		263	a, b, c, d	8·4
		264	a, b, c, d	14·3
		265	a, b, c	9·5
		266	a, b, c	15·9
	Karumpoya, 1907-A	282	a, b, c	21 5
		283	a, b, c	14·4
		284	a, b, c, d	9·7
	Edacode, 1844/1924	67	a	6 8
	Edacode, 1846/1925	75	a	11·7
			Total	236·1
1932-33	Karumpoya, 1908	321	a, b, c	7·5
		322	a, b, c	25·6
		323	a, b, c, d	26·8
		324	a, b, c	23·0
	Arevakode, 1847/1925	15	a	16·3
	Arevakode, 1847/1927	16	a	13 0
	Moolathamanna, 1847/1925	17	a	12·4
		18	a	5·5
		19	a	10·3
	Moolathamanna, 1853/1925	23	a	4.6
	Edacode, 1848/1925	76	a	7·6
			Total	152·6
1933-34	Aravallikava, 1842/1918	1	a, b	13·6
		2	a, b	10·7
	Aravallikalva, 1853/1918	3	a, b, c	18·4
	Ramalur, 1846/1926	26	a, b	4·8 (approximately)
	Ramalur, 1850/1927	27	a, b	14·6
	Elenjeri, 1846/1927	28	a	2 1
	Elenjeri, 1850/1927	29	a	4·5
		38	a	16 9
		39	a	14·3
		40	a	2·2
	Edacode, 1847/1927	61	a	22·0
	Edacode, 1845/1927	70	a	14 0
	Edacode, 1846/1926	74	a	9·8
	Edacode, 1848/1928	77	a, b	17·8
	Edacode, 1849/1927	82	a	17·5
	Edacode, 1851/1928	83	a, b, c	24·5
	Edacode, 1851/1927	86	a	13·0
		87	a	27·8
1933-34	Edacode, 1851/1928	88	a, b, c	21·3
	Moolathamanna, 1848/1927	20	a, b	17·6
			Total	287·4
1934-35	Karumpoya, 1912	330	a, b, c, d	8·1
		331	a, b, c	4·5
		332	a, b, c, d	26·3
		333	a, b, c, d	13·7
	Karumpoya, 1910	334	a, b, c	17·3
		335	a, b, c, d	24·0
		336	a, b, c	19·9
		337	a, b, c, d	21·8
		338	a, b, c	15·7
	Elenjeri, 1846/1918	30	a, b, c	10·8
	Elenjeri, 1845/1919	31	a	16·2
	Elenjeri 1849/1819	37	a	23·7
	Elenjeri, 1958/1829	41	a, b	26·1
	Edacode, 1993/1929	57	a, b	14·0
	Edacode, 1849/1929	81	a, b, c, d	24·1
	Ambalakandy, 1844/1929	243	a	0·8
	Chaliyapuram, 1844/1929	244	a, b	9·8
	Arevakode, 1848/1922	12	a	6·7
		13	a	6·8
		14	a	15 8
			Total	305·1
1935-36	Karumpoya, 1900	267	a, b, c	23 7
		268	a, b, c	14·0
		269	a, b, c	7·6
		270	a, b, c, d	12·9
		271	a, b, c, d	14·4
		272	a, b, c	18·6
		273	a, b, c, d	21·8
	Karumpoya, 1901	274	a, b, c, d	18·3
		275	a, b, c, d	32·5
		276	a, b, c, d	17·9
		277	a, b	13·4
		278	a, b	13·4
		279	a, b	9·8
		280	a, b	6·8
		281	a, b	10·1
	Karumpoya, 1911	339	a, b, c, d	25·6
		340	a, b, c	27·6
		341	a, b, c	16·4
		342	a, b, c	17·0
		343	a, b, c, d	16·5
	Karumpoya, 1908/1930	324	d, e, f	15·9
	Aravallikava, 1844/1917	5	a, b	15·9
	Elenjeri, 1846/1920	32	a	13·4
	Elenjeri, 1849/1920	34	a	6·8
		35	a	9·9
		36	a	7·6
	Elenjeri, 1858/1930	42	a, b	12·9
	Elenjeri, 1859/1930	43	a, b	14·8
		44	a, b, c	20·7
			Total	456·2

Teak Felling Series—cont.

Plan of thinning—cont.

Year of felling.	Name of block and year of plantation.	Compartment number.	Sub-compartment number.	Area in acres.
1936-37.	Edacode, 1893 ..	52	a, b, c ..	17·7
		53	a, b, c ..	16·1
		54	a, b, c, d ..	10·5
		55	a, b, c ..	4·9
		56	a, b, c, d ..	13·9
		58	a, b, c ..	3·7
		59	a, b, c ..	18·5
		60	a, b ..	6·5
	Edacode, 1893/1929 ..	57	a, b ..	14·0
	Edacode, 1894 ..	45	a, b, c, d ..	14·5
		46	a, b ..	20·4
		47	a, b, c ..	25·4
		48	a, b, c, d ..	11·2
		49	a, b, c, d ..	13·0
		50	a, b ..	21·9
		51	a, b ..	7·8
	Ramalur, 1844/1896 ..	24	a, b ..	13·6
		25	a, b ..	4·9
	Karumpoya, 1902 ..	310	a, b, c, d ..	24·9
		311	a, b, c, d ..	23·5
		312	a, b ..	6·2
		313	a, b, c ..	3·9
		314	a, b, c, d ..	15·9
		315	a, b, c ..	19·9
		316	a, b, c ..	21·6
	Karumpoya, 1905/1931 ..	321	d, e ..	21·0
	Edacode, 1846/1925 ..	75	a	11·7
	Edacode, 1844/1924 ..	67	a	6·8
	Edacode, 1844/1923 ..	65	a	4·1
	Edacode, 1845/1923 ..	68	a, b ..	9·5
		69	a	0·5
	Pannengode, 1854/1931 ..	119	a, b ..	8·5
		121	a, b, c, d ..	13·2
		122	a, b, c ..	18·9
			Total ..	448·6
1937-38.	Edacode, 1891 ..	100	a, b, c ..	13·1
		101	a, b, c ..	10·8
		102	a, b, c, d ..	10·0
		103	a, b, c ..	8·7
		104	a, b, c ..	11·9
		105	a, b, c ..	14·3
		106	a, b, c ..	18·3
		107	a, b ..	4·0

Year of felling.	Name of block and year of plantation.	Compartment number.	Sub-compartment number.	Area in acres.
1937-38. —*cont.*	Edacode, 1892 ..	108	a, b ..	10·0
		109	a, b, c ..	6·9
		110	a, b ..	9·8
		111	a, b ..	9·3
		112	a, b, c ..	7·6
		113	a, b, c ..	5·3
		114	a, b, c ..	19·5
		115	a, b, c, d ..	18·3
		116	a, b, c ..	8·0
		117	a, b ..	11·0
		118	a, b, c ..	7·3
	Karumpoya, 1904 ..	300	a, b, c, d ..	17·9
		301	a, b, c, d ..	5·8
		302	a, b, c ..	8·5
		303	a, b, c ..	12·4
		304	a, b, c, d ..	11·0
		305	a, b, c ..	16·2
	Karumpoya, 1903 ..	306	a, b, c, d ..	5·3
		307	a, b, c, d ..	16·1
		308	a, b, c, d ..	22·7
		309	a, b, c ..	18·8
	Karumpoya, 1907-B.	317	a, b, c ..	20·4
		318	a, b ..	17·8
		319	a, b, c ..	16·5
		320	a, b ..	8·1
	Karumpoya, 1905 ..	290	a, b, c ..	9·8
		291	a, b, c ..	7·5
		292	a, b, c ..	8·9
		293	a, b, c ..	5·1
		294	a, b ..	12·2
		295	a, b ..	4·5
		296	a, b ..	11·4
		298	a, b, c ..	19·0
		299	a, b ..	6·8
	Arevakode, 1847/1925 ..	15	a	16·3
	Arevakode, 1847/1927 ..	16	a	13·0
	Moolathamanna, 1847/1925	17	a	12·4
		18	a	5·5
		19	a	10·3
	Moolathamanna, 1853/1925	23	a	4·6
	Edacode, 1848/1925 ..	76	a	7·6
	Pannengode, 1854/1932 ..	123	a, b ..	18·2
	Pannengode, 1856/1932 ..	128	a, b, c, d ..	21·0
		129	a, b, c ..	21·3
			Total ..	617·0

NOTE.—Thinning invariably includes climber cutting, removal of parasites, freeing teak from bamboos, etc.

Teak Felling Series—cont.

Plan of subsidiary tending.

252—

Year.	Cutting climbers ; removing loranthus ; harvesting dead and top-broken trees ; cutting bamboos injuring teak.	Cutting climbers ; removing loranthus ; cutting bamboos injuring teak.
1928–29.	Walluvasseri plantations 1864, 1865, 1866/A, 1868/C, 1869/B, 1866/B, 1867/A, 1867/B, 1868/A, 1868/B and 1869/A.	Karumpoya plantations 1906, 1907/A and 1909.
1929–30.	Chatomborai plantations 1872, 1873, 1874 and 1875. Elenjeri 1846, compartment 33.	......
1930–31.	Old Amarampalam plantations 1868, 1873, 1874, 1875 and 1876/A, B, C.	... ..
1931–32.	Nellicutta plantations 1870 and 1871 ...	Pannengode plantation 1864.
1932–33.	Pannengode plantation 1863	...
1933–34.	......	Walluvasseri plantations 1865, 1866/A, 1868/C, 1869/B, 1866/B, 1867/A and 1868/A.
1934–35.	. ...	Walluvasseri plantations 1867/B, 1868/B and 1869/A. Chatomborai 1872 and 1873.
1935–36.	... ..	Pokode plantations 1889 and 1890. Chatomborai 1874 and 1875.
1936–37.	......	Walluvasseri plantation 1888. Elenjeri 1846, compartment 33
1937–38.	...	Old Amarampalam plantations 1868, 1873, 1874 and 1875. Karumpoya 1897, 1898 and 1899.

NOTE.—(1) The above operations are in addition to similar operations which have to be undertaken at the time of thinning.

(2) Second rotation plantations are to be inspected annually and tended as required.

253—

Plan of formation and tending of underwoods.

Year of working.	Locality.	Nature of operation.
1928–29	Pannengode plantation 1887	Replacement of casualties amongst Hopea and Mahogany and freeing natural tree seedlings, etc.
	Pannengode compartment 132	Experimental introduction of Macaranga Roxburghii and Vitex Negundo in an area of bad grass.
	Pannengode plantation 1886 ... ... Karumpoya plantation 1900	Freeing natural tree seedlings, etc.
1929–30	Chatomborai plantation 1872 ...	Sowing bamboo in all grassy areas.
	Walluvasseri compartments 171, 172 and 174. Pannengode compartments 130, 131 and 132.	Introduction of fast-growing underwood in bad grassy areas, guided by 1928 experiments.
	Karumpoya plantations 1901 and 1907 A.	Freeing natural tree seedlings, etc.
1930–31	Walluvasseri compartments 171, 172 and 174. Pannengode compartments 130, 131 and 132.	Replacement of 1929 casualties, where necessary, in grassy areas.
	Walluvasseri compartments 150, 151 and 152.	Freeing natural tree seedlings, etc., where understorey scanty, i.e., near the river.
	Karumpoya plantations 1903 and 1904.	Freeing natural tree seedlings, etc.
1931–32	Edacode compartments 45, 47 and 48 ... Karumpoya plantations 1897 ...	Freeing natural tree seedlings, etc.
	Edacode compartment 63-*c* and hill-tops in compartments 46, 47, 48, 49, 53, 58 and 59.	Establishment of Hopea centres under suitable shade.
1932–33	Edacode compartments 49, 54 and 55 ... Karumpoya plantations 1898 and 1899 ...	Freeing natural tree seedlings, etc.
	Edacode compartment 63*c*, and hill-tops in compartments 46, 47, 48, 49, 53, 58 and 59.	Replacement of casualties in Hopea centres.
1933–34	Edacode compartments 59 and 60 ... Karumpoya plantations 1905, 1906 and 1902.	Freeing natural tree seedlin:s, etc.

Teak Felling Series—cont.

Plan of formation and tending of underwoods—*cont.*

Year of working.	Locality.	Nature of operation.
	Edacode compartment 63*c*, and hill-tops in compartments 46, 47, 48, 49, 53, 58 and 59.	Replacement of casualties in Hopea centres.
1934–35	Edacode compartments 100, 101 and 102. Karumpoya plantations 1907 B and 1908.	Freeing natural tree seedlings, etc.
	Edacode compartments 117*d*, 118 *e*, and hill-tops in compartments 101, 105, 113 and 114.	Establishment of Hopea centres under suitable shade
1935–36	Edacode compartments 103, 104 and 105. Karumpoya plantations 1910 and 1912 ...	Freeing natural tree seedlings, etc.
	Edacode compartments 117*d*, 118*e* and hill tops in compartments 101, 105, 113 and 114.	Replacement of casualties in Hopea centres.
1936–37	Edacode compartments 114 and 117 ... Karumpoya plantation 1911	Freeing natural tree seedlings, etc.
	Edacode compartments 117 *d*, 118 *e* and hill-tops in compartments 101, 105, 113 and 114.	Replacement of casualties in Hopea centres.
1937–38	Pokode compartments 208, 209, 210, 211, 215 and 219. Karumpoya plantation 1909	Freeing natural tree seedlings, etc.
	Pokode compartment 220 *d* and hill-tops in compartments 208, 209, 210.	Establishment of Hopea centres under suitable shade.

NOTE.—To complete the underwood programme, casualties in Hopea centres established in 1937 must be replaced in 1938 and 1939.

Teak Felling Series

Plan of Reclamation of Failed Areas for Teak.

254—

Year of working.	Nature of operation. Establishing Tephrosia candida. Block, compartment and sub-compartment.	Area in acres.	Sowing Bambusa arundinacea. Block, compartment and sub-compartment.	Area in acres.	Planting cuttings of Vitex Negundo. Block, compartment and sub-compartment	Area in acres.	Clearing and re-planting with Teak. Block, compartment and sub-com. partment.	Area in acres.
1928–29	Elenjeri, 35 *b*.	1·3	Elenjeri, 34 *b*.	11·3	Arevakode, 12 *b*.	4·2	..	..
	Aravallikava 5 *c*.	0·9	Elenjeri, 36 *b*.	7·6	Arevakode, 13 *b*.	3·6	..	..
			Aravallikava, 6 *a*.	5·1	Arevakode, 14 *b*.	4·7	..	..
			Aravallikava, 9 a.	3·1	Elenjeri, 37 *c*.	2·0	..	..
1929–30	Edacode, 65 *b*.	6·8	Edacode, 73 *a*	14·2	..	..	..	..
	Edacode, 67 *b*.	2·1	Edacode, 76 *b*.	5·3	..	..	..	..
	Edacode, 75 *b*.	2·2	Edapode, 78 *a*.	5·3	..	..	..	..
1930–31	..	..	..	..	..	..	..	..
1931–32	..	..	..	..	..	..	Elenjeri, 35 *b*.	1·3
							Aravallikava 5 *c*.	0·9
							Edacode, 80 a.	14·4
1932–33	..	..	..	..	..	..	Edacode, 65 *b*.	6·8
							Edacode, 67 *b*.	2·1
							Edacode, 75 *b*.	2·2
1933–34	..	..	..	..	..	..	Elenjeri, 31 *c*.	3·5
							Elenjeri, 32 *b*.	1·5
1934–35	..	..	..	..	..	..	Elenjeri, 37 *c*.	2·0
1935–36	..	..	..	..	..	..	Arevakode, 12 *b*.	4·2
							Arevakode, 13 *b*.	3·6
							Arevakode, 14 *b*.	4·7

NOTES.—(1) Heavy casualties amongst the shrubs (if they occur) should be replaced in the year after introduction.
(2) Tephrosia candida should be pruned as required. No years have been specified.
(3) The years given for replanting teak are entirely provisional, and will depend on the success, or otherwise, of the introduction of undergrowth, and, in the case of compartments 80, 31 and 32, on the appearance of these areas.

SECTION 6—MISCELLANEOUS FELLING SERIES—METHOD OF TREATMENT.

255. *Choice of species.*—Many of the failed areas of the first rotation have already been stocked, naturally, with valuable species other than teak, and this process is still proceeding in the younger areas. These natural crops are more or less regular, though in the oldest there is a small proportion of mature, or almost mature trees amongst the poles. On laterite soils, Xylia xylocarpa is the chief species, with scattered specimens of other valuable species such as rosewood, Terminalia paniculata and Lagerstrœmia microcarpa. In swampy localities, Terminalia tomentosa is the principal valuable species, though Terminalia paniculata also occurs. Some teak survives in most of the areas, but it is usually very poor. Softwoods and bamboos occur, to a greater or less extent, in practically all the failed areas, being so common in a few places as to form the major part of the crop. The failed areas of the second rotation are covered with weed growth (woody and herbaceous) and usually contain some stunted teak plants, with or without a scattered distribution of coppice growth of teak, Terminalias, Xylia xylocarpa, Lagerstrœmia microcarpa, Macaranga Roxburghii, Cleistanthus collinus, etc. Rosewood is present to some extent, either in the form of root-suckers or coppice, or occasionally, as poles and saplings (often top-broken or mis-shapen) which were retained when the first rotation teak crop was felled. In areas which have a reasonable stocking of valuable species, or where natural regeneration is proceeding, it is believed that Nature's choice of species is the best, and that the obvious treatment is to tend these crops in such a way as to make them more regular, to improve the condition of the valuable species, and to eliminate the softwoods and bamboos wherever valuable tree species occur. The thinning and cleaning hereafter prescribed will be undertaken with this object in view, but one modification must be observed. In many parts of the failed areas in laterite localities, the shade conditions are suitable for the artificial introduction of Hopea parviflora, and where the establishment of this species is desirable in order to provide a future underwood in neighbouring teak plantations, it is to be introduced. In one instance (the Arimbrakutta plantations, where teak is a complete failure) Hopea parviflora is chosen purely on its own merits, as being the most suitable crop for the areas in question. Swampy localities, in teak plantations due for final felling, are to be stocked with Terminalia tomentosa, when the teak plantations are re-formed. The introduction of this species is also prescribed experimentally in a small area in a young plantation, where the crop is open and consists mainly of inferior species. The artificial introduction of rosewood is prescribed in about 25 acres, partly because the present crop consists largely of inferior species, and partly as an experiment whose lessons can be applied in large areas (notably in the Chatomborai plantations of 1874 and 1875) in the next working plan period. In the failed areas of the second rotation, it is believed that many of the laterite slopes will be suitable for rosewood, when the soil has been improved. In these areas tending is desirable in order to encourage all such tree species (mostly coppice) as occur. Artocarpus integrifolia (or possibly Artocarpus hirsuta) has been chosen for a few small areas where it is thought that all conditions are suitable for the immediate establishment of this species at a small cost. This operation, also, may be regarded as an experiment. The only other artificial regeneration prescribed, in second rotation failed areas, is the introduction of Terminalia tomentosa in a few small areas where there is already a sparse stocking of this species as a result of recent planting.

256. *Silvicultural system.*—It is hoped that most parts of this Felling Series will, in the future, lend themselves to natural regeneration under some form of shelter-wood. For the present, such artificial regeneration as is prescribed will be done in various ways, and the remainder of the crops will be tended as regular high forests.

257. *Rotation.*—The rotation cannot be fixed at present. Different rotations for different species, or groups of species, will probably be required eventually.

258. *Regulation of the yield.*—The yield during the next 10 years will be small, and cannot be regulated. All saleable material which is cut shall be extracted.

Prescriptions.

259. *Fellings.*—Felling shall be executed with the least possible damage to the trees left standing. The rules for marking stumps, numbering logs, measurement and recording of the yield, as prescribed in the case of the Teak Felling Series, shall be followed as far as is practicable.

260. *Artificial regeneration—(a) Terminalia tomentosa.*—In most of the areas prescribed for regeneration with Terminalia tomentosa, there are already some scattered poles of this species and of Terminalia paniculata. Good poles and saplings should be left standing, both to provide a certain amount of shade, and to prevent the localities becoming too swampy. Other tree growth and bamboos shall be felled. Saleable trees shall be extracted, and the tops of bamboos may be utilized for floating. The debris shall be burnt, as described for the Teak Felling Series. For the earlier regeneration of Terminalia tomentosa, the espacement shall be 6′ × 6′. But if it is found that casualties during the first few years are light, the espacement may be increased to 9′ × 9′. The method of regeneration should combine cheapness with efficiency. It is left to the management to choose a method or combination of methods, from the following: direct sowing, planting nursery seedlings, planting germinating seeds, and planting stumps. *All that is definitely prescribed is that the area must be completely stocked in the year of formation*, and as early as possible in the monsoon. The most suitable form of weeding must also be evolved. Clean-weeding appears to attract browsing animals. It will possibility be sufficient to keep the heads of the seedlings free of weed growth. A clearing is prescribed in the second year. Casualties will then be replaced if necessary.

(*b*) *Rosewood.*—The area selected for regeneration with rosewood is in a locality where a suitable class of cultivator was found for "ponam" regeneration in 1926. If possible, the rosewood should be grown with a paddy crop, and if this can be done, the area shall be cleared and burnt, retaining only good natural saplings of rosewood, of which there are a few. (The actual regeneration should be done departmentally.) If cultivators do not come forward, good poles and saplings of all valuable species shall be retained. Other saleable trees shall be extracted. Unsaleable material shall be cut and burnt, and rosewood shall be introduced under the broken shade that remains. Planting of one-year old stumps will possibly be the most suitable method, whether the regeneration is undertaken with or without field crops, but the method of regeneration is not definitely laid down. The espacement should be 8′× 8′, whether field crops are cultivated or not. If the method of stump-planting is adopted, the nursery must be made a year in advance. The area must be fully stocked in the year of formation, and as early as possible in monsoon. Subsequent weeding and tending shall be carried out in whatever way is found to be most suitable. It will probably be sufficient to keep the heads of the plants free of weeds. A cleaning is prescribed in the second year. Casualties will then be replaced if necessary.

(*c*) *Artocarpus integrifolia.*—In the areas selected, it is thought that Artocarpus integrifolia will be better than Artocarpus hirsuta. (The latter may be tried as well, though it is very doubtful whether the shade is suitable.) Narrow lines will probably have to be cut through the undergowth, to facilitate regeneration and inspection. The lines should be 8 feet apart. The plants should be put in the undergrowth, 1 foot from one of the edges of each cleared line, and 8 feet apart. The espacement will therefore be 8′ × 8′. One-year old stumps should be planted in crow-bar holes, early in the monsoon. Two to three inches of stem and 9 inches of root should be left. The hole must be exactly as deep as the root is long, and the soil must be packed very tightly round the stump, using the crow-bar to close the hole. To get one-year old stumps, the nursery must be made a year in advance. Good ripe fruits are usually available in May. The seeds must be sown as soon as the fruits are collected. Germination is good, but the nursery must be protected from all animals (including rats) while the seed remains attached to the seedling, and from monkeys and browsers thereafter. Subsequent to planting out, tending should be confined to keeping the heads of the plants reasonably free from weeds, remembering that any disturbance of the undergrowth is likely to attract animal enemies.

(*d*) *Hopea parviflora.*—Favourable shade conditions for raising Hopea are difficult to describe, but they can soon be learnt in practice. Similar or heavier shade to that found in the Forest Research Officer's plot in natural forest in Pannengode and in the Working Plan Officer's plot in old Amarampalam compartment 233 is suitable. Heavy undergrowth is unfavourable. In all sub-compartments where Hopea regeneration is prescribed, areas with suitable shade shall be selected by the

District Forest Officer and staked at an espacement of 9′ × 9′. Up to the present, the method of planting one-year old nursery seedlings has been found to be the most reliable. This method should therefore be followed, unless a better one is found. The nurseries must be made in the year before the plants are required. They should be made in the same way as teak nurseries, but must be shaded either naturally by trees or artificially by means of slats of split bamboo, or by a combination of both. The fruit must be collected as soon as it ripens and sown within four days. The nurseries shall be watered as required before and during breaks in the monsoon. After the monsoon, little watering will be required if the nursery soil is kept ærated. When sufficient local seed is not available, it can be got from Mount Stuart or South Kanara. Where the soil is hard (as laterite soil usually is even in the monsoon), it is advisable to loosen it with a pickaxe at the time of planting. Planting must be done in rainy weather, early in the monsoon. The advisability of planting two seedlings at each stake may be considered. The areas must be left fully stocked at the end of the first monsoon. Casualties will be replaced in the second and third years. During the first three years, it is probable that the only tending required will be the freeing of the heads of the plants. Clean weeding is dangerous. Subsequent tending is left to the discretion of the local officers. Thinnings have been prescribed, in definite years, for all failed areas, and the requirements of the young Hopea must be considered in these years and at other times if necessary. In this as in all kinds of regeneration, close supervision of the work is essential.

261. *Thinning and cleaning.*—It is impossible to formulate exact prescriptions for thinning and cleaning in the Miscellaneous Felling series. These are purely silvicultural operations requiring the careful consideration of responsible officers. The District Forest Officer should personally mark as much of the thinnings as possible and should direct the cleaning and tending according to the requirements of each crop. In areas where no artificial regeneration is prescribed or contemplated, the object of thinning and cleaning is to promote the rapid development of regular crops of the most valuable species. The operations will include thinning amongst the valuable species themselves, removal of bamboos and softwoods wherever prejudicial to the growth of valuable species, climber cutting, etc. In areas which adjoin plantations where teak final fellings are in progress or have been completed, it is advisable to remove all the teak which survives in the failed areas. In other areas, teak should only be retained if it is necessary in the canopy, or if it is likely to put on quality increment, or if it is unsaleable at a profit. After the introduction of Hopea in suitable areas, the requirements of this species must receive first consideration during thinning and cleaning. The best development of the overwood must also be promoted, but it is of secondary importance. In all cases, saleable thinnings shall be extracted. Areas regenerated artificially with other species will be found in the programme of thinning and cleaning. In these areas such tending as is found desirable will be carried out. When tending the Artocarpus areas, climbers on scattered saplings and coppice shoots of teak and other valuable species should be cut. In Edacode compartments 62 *m*, 71 *m*, 78 *m*, 79 *m*, 84 *m*, and 85 *m*, the object of cleaning is to encourage the growth of all tree species, valuable and inferior, so as to cover the ground, and improve the soil for concentrated regeneration at some future date. In these areas coppice shoots of teak and other valuable species should be reduced to one per stool. All other growth of tree species (whether coppice seedling or sucker) should be retained, and assisted by climber cutting and freeing from weed growth. Finally, Government elephants should not be discouraged from frequenting certain of the swampy failed areas near Nedungayam where bamboo is plentiful. (Other grazing grounds are scarce in this vicinity.)

262. *Tabular statements of operations.*—In the next three paragraphs the programme of felling, artificial regeneration, thinning and cleaning is prescribed. To simplify the management, practically all these operations have been allotted to years in which similar operations are due in neighbouring localities of the Teak Felling Series.

Miscellaneous Felling Series.

Plan of final felling.

263.—

Year.	Name of block and year of plantation.	Compartment, sub-compartment, etc.	Area in acres.
			ACS.
1928-29..	Elacode 1847	61 *m*	2·3
1929-30..	Old Amarampalam 1876 C	236 *m*	15·3
	Old Amarampalam 1875	239 *m*	10·4
		Total ..	25·7
1930-31..	Pannengode 1864 ..	122 *m*	1·3
1931-32..	Pannengode 1854 ..	123 *m* (central area)..	2·2
	Pannengode 1856 ..	129 *m*	0·9
	Karumpoya 1901 ..	274 *m*	1·5
	Karumpoya 1901 ..	281 *m*	1·4
	Karumpoya 1907 A ..	282 *m*	3·5
		Total ..	9·5
1932-33..	...	....	..
1933-34..	....	....	..
			ACS.
1934-35..	Edacode 1861 ..	91 *m* (south-east area).	1·6
	Edacode 1861 ..	92 *m* (small area) ..	0·2
	Edacode 1861 ..	93 *m* (north area) ..	2·4
	Edacode 1861 ..	94 *m* (north area) ..	1 3
	Edacode 1861 ..	95 *m* (small area) ..	0·5
	Edacode 1862 ..	98 *m*	0·9
		Total ..	6·9
1935-36	Edacode 1862 ..	99 *m*	1·7
1936-37..	Pannengode 1864 ..	145 *m*	1·0
	Pannengode 1864 ..	146 *m*	0·1
		Total ..	1·1
1937-38..	Walluvasseri 1864 ..	156 *m*	3·4
	Walluvasseri 1864 ..	157 *m*	1·5
	Pozhayi Mangalasseri 1844	246 *m*	0·9
		Total ..	5·8

Miscellaneous Felling Series.

Plan of artificial regeneration.

264.—

Year of working.	Introduction of Terminalia tomentosa.		Introduction of Rosewood (preferably with field crops).		Introduction of Artocarpus integrifolia and or Artocarpus hirsuta.		Introduction of Hopea parviflora wherever shade is suitable.	Replacement of casualties in Hopea areas.
	Locality.	Area in acres.	Locality.	Area in acres.	Locality.	Area in acres.	Locality.	Locality.
1928-29..	Moolathamanna compartments —17 *m* ; 18 *m* ; 19 *m* ; 23 *m*.	ACS. 5·0	....	..	....	..	Walluvasseri compartments—148 *m*; 150 *m*; 151 *m*; 154 *m* ; 155 *m*. Pannengode compartments—123 *m* (small area) ; 130 *m* ; 136 *m* ; 137 *m* (large area) ; 138 *m* (south area). Old Amarampalam compartments—233 *m* (outside experimental area) ; 234 *m* ; 235 *m*.	Old Amarampalam compartment—225 *m*.
1929-30..	Edacode compartment—61 *m*.	2·3	....	..	.. .	..	....	Walluvasseri compartments—148 *m* ; 150 *m* ; 151 *m* ; 152 *m* ; 154 *m* ; 155 *m*. Pannengode compartments —123 *m* (small area) ; 130 *m* ; 136 *m* ; 137 *m* (large area) ; 138 *m* (south area). Old Amarampalam compartments—225 *m*; 233 *m* (outside experimental area) ; 234 *m* ; 235 *m*.
1930-31..	....	..	Old Amarampalam compartments—236 *m* ; 239 *m*.	25·7	Elenjeri compartments—34 *m* ; 35 *m*; 37 *m*.	15·0	....	Walluvasseri compartments—148 *m* ; 150 *m* ; 151 *m* ; 152 *m* ; 154 *m* ; 155 *m*. Pannengode compartments — 123 *m* (small area) ; 130 *m* ; 136 *m* ; 137 *m* (large area) ; 138 *m* (south area). Old Amarampalam compartments—233 *m* (outside experimental area) ; 234 *m* ; 235 *m*.
1931-32..	Pannengode compartment—122 *m*.	1·3	....	..	....	..	Elenjeri compartments —38 *m* ; 39 *m* ; 40 *m*. Edacode compartments—63 *m* ; 87 *m* ; 51 *m* ; 52 *m*. Arimbrakutta compartments—240 *m* ; 241 *m* ; 242 *m*.	
1932-33..	Pannengode compartments—123 *m* (central area), 129 *m*. Karumpoya compartments—274 *m* ; 281 *m* ; 282 *m*.	9·5	....	..	Edacode compartment—72 *m*.	2·08	....	Elenjeri compartments—38 *m* ; 39 *m* ; 40 *m*. Edacode compartments—63 *m* ; 87 *m* ; 51 *m* ; 52 *m*. Arimbrakutta compartments—240 *m* ; 241 *m* ; 242 *m*.
1933-34..	....	..	....	..	....	..		Elenjeri compartments—38 *m* ; 39 *m* ; 40 *m*. Edacode compartments—63 *m* ; 87 *m* ; 51 *m* ; 52 *m*. Arimbrakutta compartments—240 *m* ; 241 *m* ; 242 *m*.
1934-35..	....	..	....	..	....	..	Edacode compartments—90 *m* ; 91 *m* (laterite areas) ; 92 *m* (large area) ; 93 *m* (south area) ; 94 *m* (south area) ; 95 *m* (north area) ; 100 *m* ; 106 *m* ; 107 *m* ; 108 *m* ; 111 *m* ; 12 *m*.	

Miscellaneous Felling Series—cont.

Plan of artificial regeneration—*cont.*

Year of working.	Introduction of Terminalia tomentosa.		Introduction of Rosewood (preferably with field crops).		Introduction of Artocarpus integrifolia and/or Artocarpus hirsuta.		Introduction of Hopea parviflora wherever shade is suitable.	Replacement of casualties in Hopea areas.
	Locality.	Area in acres.	Locality.	Area in acres.	Locality.	Area in acres.	Locality.	Locality.
1935-36..	Edacode compartments—91 *m*(south-east area); 92 *m* (small area); 93 *m* (north area); 94 *m* (north area); 95 *m* (small area); 98 *m*.	ACS. 6·9	....	..	....	..		Edacode compartments—90 *m*; 91 *m* (laterite areas); 92 *m* (large area); 93 *m* (south area). 94 *m* (south area); 95 *m* (north area); 100 *m*; 106 *m*; 107 *m*; 108 *m*; 111 *m*; 112 *m*.
1936-37..	Edacode compartment—99 *m*.	1·7	....	..	....	..		Edacode compartments—90 *m*; 91 *m* (laterite areas); 92 *m* (large area); 93 *m* (south area); 94 *m* (south area); 95 *m* (north area); 100 *m*; 106 *m*; 107 *m*; 108 *m*; 111 *m*; 112 *m*.
1937-38..	Pannengode compartments—145 *m*; 146 *m*.	1·1	....	..	....	..	Pokode compartments—212 *m*; 213 *m*; 214 *m*; 215 *m*; 216 *m*; 217 *m*; 218 *m*; 219 *m*.	
	Totals ..	27·8	....	25·7	....	36·0	....	....

NOTE.—To complete this programme, casualties in the Hopea areas of 1937 have to be replaced in 1938 and 1939 and Terminalia tomentosa must be introduced in 1938 in compartments 156 *m*, 157 *m* and 246 *m*.

Miscellaneous Felling Series.

Plan of thinning and cleaning.

265.—

Year of working.	Name of block.	Compartments and sub-compartments.	Area in acres
1928–29	Edacode	50 m; 62 m; 69 m; 71 m; 78 m; 79 m; 84 m; 85 m	117·5
	Karumpoya	330 m; 332 m; 340 m; 341 m; 342 m; 343 m	23·8
1929–30	Moolathamanna	17 m; 18 m; 19 m; 23 m	5·0
	Edacode	100 m; 106 m; 107 m; 108 m; 111 m; 112 m.	27·0
	Pokode	212 m; 213 m; 214 m; 215 m; 216 m	27 0
	Karumpoya and New Amarampalam.	290 m; 291 m; 292 m; 293 m; 294 m; 296 m; 297 m; 298 m; 299 m; 304 m; 305 m; 306 m; 308 m; 309 m; 344 m	105 8
1930–31	Edacode	61 m	2·3
	Pannengode	130 m; 136 m; 137 m; 138 m	22 6
	Walluvasseri	148 m; 149 m; 150 m; 151 m; 152 m; 153 m; 154 m; 155 m	26·3
	Pokode	217 m; 218 m; 219 m	26·0
	Karumpoya	252 m; 256 m; 257 m; 287 m; 288 m; 289 m; 326 m; 327 m; 328 m; 329 m	81·7
	Old Amarampalam	222 m; 231 m	28·1
1931–32	Elenjeri	34 m; 35 m; 37 m	15·2
	Pannengode	139 m; 141 m; 142 m	3·0
	Old Amarampalam	236 m; 239 m	25·7
	Karumpoya	258 m; 259 m; 260 m; 261 m; 262 m	33·4
1932–33	Pannengode	122 m; 124 m; 125 m; 126 m; 127 m	83·1
	Moolathamanna	17 m; 18 m; 19 m; 23 m	5·0
	Karumpoya	321 m; 322 m; 323 m	27·0
1933–34	Edacode	72 m; 62 m; 69 m; 71 m; 78 m; 79 m; 84 m; 85 m	133·1
	Pannengode	123 m; 129 m	3·6
	Karumpoya	274 m; 281 m; 282 m	6·4
1934–35	Walluvasseri	177 m; 178 m	36·8
	Karumpoya	330 m; 332 m; 334 m; 338 m	36·0
1935–36	Karumpoya	271 m; 340 m: 341 m; 342 m; 343 m	13·9
1936–37	Edacode	91 m (south-east area); 92 m (small area); 93 m (north area); 94 m (north area); 95 m (small area); 98 m; 50 m; 51 m; 52 m; 61 m	28·6
	Pannengode	122 m	1·3
1937–38	Moolathamanna	17 m; 18 m; 19 m; 23 m	5·0
	Edacode	99 m; 100 m; 106 m; 107 m; 108 m; 111 m; 112 m	28·7
	Old Amarampalam	225 m; 233 m; 234 m; 235 m; 236 m; 237 m; 238 m; 239 m	86·6
	Elenjeri	34 m; 35 m; 37 m	15 2
	Karumpoya and New Amarampalam.	290 m; 291 m; 292 m; 293 m; 294 m; 296 m; 297 m; 298 m; 299 m; 304 m; 305 m; 306 m; 308 m; 309 m; 344 m	105·8
	Pannengode	123 m; 129 m	3·6
		Total area for period 1928–29 to 1937–38	1,140·1

SECTION 7—PRESCRIPTIONS COMMON TO BOTH FELLING SERIES.

266. *Fire protection.*—The fire-lines to be maintained are marked on the maps. All exterior fire-lines shall be scraped clean, to a breadth of 20 to 30 feet, every year. In the Amarampalam range the interior fire-lines, also, shall be scraped clean every year, but to a breadth of 10 feet only. The interior fire-lines of the Nilambur range have been divided into two net-works, which are marked on a map recorded in the District Forest office. These net-works will be scraped clean to a breadth of 10 feet in alternate years. Fire patrols shall be appointed annually, in the fire season, as at present. Their duty will be to keep the fire-lines swept clean of dead leaves. The leaves shall be burnt in the middle of the fire-lines.

267. *Protection against animals.*—It is difficult to keep wild elephants away, so it is fortunate that they frequent only a few parts of this working circle. Government elephants are capable of considerable damage to the crop in young plantations,

and to the underwood in the older plantations. They sometimes strip the bark off old trees also. It is essential to keep them out of young plantations, and they should be excluded from older plantations also, as far as possible. (An exception is made in the case of swampy failed areas near Nedungayam, as mentioned in the preceding section.) Where elephant cooking sheds have to be located in the plantations, it is desirable to erect stockades round the teak trees in the immediate vicinity. Protection of young teak plantations against cattle has been prescribed already. Stems of all species which happen to be damaged by other animals shall be coppiced, in the first two years at any rate.

268. *Protection against insects.*—The investigation of the question of teak defoliation is in the hands of the Imperial Entomologist, so the management need take no steps in the matter for the present. In plantations of any species, two years old and under, stems damaged by borers shall be coppiced.

269. *Cost of regeneration.*—It has been pointed out in Part I that the present costs of practically all works are too high, and it must be the first aim of the management to reduce them, consistent with efficient execution. Since high costs have ruled for some years, and since many of the present working plan prescriptions are new, it is not easy to say what may be regarded as reasonable expenditure. The first column of the following table is the writer's estimate of what the main regeneration works should cost, but it is hardly to be expected that these rates can be enforced immediately. Reduction must come gradually, and it can only be effected by continuous and close supervision. The rates given in the second column can probably be enforced at once, or in the very near future.

Formation of teak plantations.

Operation.	Cost per acre. RS.	A.	P.		RS.	A.	P.
First year—							
Felling unsaleable material	1	0	0	to	2	0	0
Burning	4	0	0	to	7	0	0
Collection of seed	1	8	0	to	2	8	0
Cost of stakes and staking	1	8	0	to	2	8	0
Breaking soil at stakes	1	8	0	to	2	0	0
Raising and tending nursery	3	0	0	to	4	0	0
Planting	1	8	0	to	2	0	0
First weeding and replacing casualties	2	0	0	to	4	0	0
Second weeding and soil working	6	0	0	to	9	0	0
Total, first year ...	22	0	0	to	35	0	0
Second year—							
Weeding	7	0	0	to	9	0	0
Introduction of cover crop	2	0	0	to	4	0	0
Miscellaneous—							
(Including pruning, etc.)	2	0	0	to	3	0	0
Total cost of formation by planting	33	0	0	to	51	0	0
For direct sowing reduce by	2	8	0	to	1	8	0
Total cost by direct sowing	30	8	0	to	49	8	0

In the miscellaneous felling series, the introduction of Hopea parviflora will probably cost between Rs. 10 and Rs. 14 per acre, for three years' work.

270. *Choice of tools.*—The choice of implements, for various works, should fall on those with which each work can be done most cheaply and efficiently. One suggestion may be made. The general shape of the mamotty is suitable for Indian labourers, but digging with this implement is very expensive. If a head, with two or three steel prongs, were to be substituted for the solid steel head, it is probable that hand digging would be cheaper than ploughing in the teak plantations, and it would certainly be more desirable.

271. *Maintenance of compartment boards.*—The boards, marked with compartment numbers, shall be maintained at all corners of compartments, and shall be repainted as required. When missing boards have to be replaced, they should have the numbers engraved in the wood, in addition to painting.

Section 8.—Control.

272. *General.*—Correct and annual control of the execution of the working plan prescriptions is of the first importance. The following control forms shall be maintained for the Plantation Working Circle:—Control Book, Record of Works, and Compartment History. These forms are briefly described in the following paragraphs, and sample forms will be found in Appendix A. A certain amount of mapping will also be required and this is described hereafter. The District Forest Officer will be personally responsible for the accurate posting of all control forms and maps.

273. *Control Book.*—The final fellings of the Plantation Working Circle shall be controlled in the Control Book. The first entries of each year will deal with the Teak Felling Series, and will be followed by those pertaining to the Miscellaneous Felling Series.

274. *Record of works.*—The record of works will compare the execution of all works, except final fellings, with the prescriptions of the working plan. (Most of the latter will be found in the tabular statements of operations for each felling series.) The first entries of each year will pertain to the teak felling series The second set of entries will apply to the miscellaneous felling series, and a third set of entries will deal with works common to the whole working circle, e.g., fire protection, etc.

275. *Compartment history.*—The writer has compiled a complete set of forms containing the description of each compartment, and its history to date. These forms will be printed and bound into books, with several blank pages for subsequent additions to the history. All items of history shall be recorded briefly, every year. The details of yield from thinnings and such subsidiary operations as harvesting dead and wind-broken trees, shall be entered, and the total yields from each compartment shall be compared with the yield table estimates. It is also of interest to enter the yield from final fellings, even though they are controlled in the Control Book. In fact the compartment history is incomplete if they are omitted.

276. *Maps.*—A set of uncoloured maps of the plantations shall be maintained as fire-maps. Any areas which are burnt shall be marked and numbered. A reference table in the margin will contain brief details of the year of fire, cause of fire, and extent of damage. Another set of maps (preferably the coloured stock maps) shall be kept up to date by mapping the following details:—(*a*) permanent sample plots, as soon as the number of permanent plots has been fixed, (*b*) areas in the teak felling series which are regenerated in any but the ordinary way, e.g., coppice regeneration, change of species, etc., (*c*) areas in both felling series where Hopea parviflora is introduced.

CHAPTER III.—WORKING PLAN FOR THE CONVERSION WORKING CIRCLE.

Section 1—General Constitution of the Circle and Character of the Vegetation.

277. *Area.*—The total area of the Conversion Working Circle is 24,877 acres.

278. *General constitution.*—It consists of (i) all the natural forests in the Nilambur range (8,243·0 acres), (ii) all the natural forests of the plains and part of the natural forests of the foot-hills in the Amarampalam range (15,616·9 acres) and

(iii) an area of 1,017·1 acres which has been artificially regenerated, with varying success, between the years 1916 and 1927. Of the area so regenerated, 240·1 acres are in the Nilambur range, and 777 acres in the Amarampalam range.

279. *General character of the vegetation.*—In Part I, Chapter II, the types found in the natural forests of the plains and foot-hills have been described in detail. In prescribing the treatment of the natural forests of the Conversion Working Circle, the following are the main characteristics of the vegetation which have had to be considered :—(*a*) the paucity of regeneration of valuable tree species over large tracts of forest ; (*b*) the prevalence of bamboo in large areas, preventing the natural regeneration of light-demanding species, and ruling out the possibility of any form of artificial regeneration other than concentrated ; (*c*) the existence of some forests where the crop consists almost entirely of mature trees, with practically no regeneration of valuable species ; (*d*) the existence of areas which are reasonably stocked with natural pole crops of valuable species, and which can be converted to approximately even-aged woods by removing the scattered overwood of big trees, eliminating softwoods, and thinning and tending the poles ; and (*e*) the wide distribution of mature and over-mature trees which ought to be felled soon, if their timber is to be saved from decay. As regards the areas already regenerated, a description of each crop will be found in the history and description of compartments. Teak has been the chief species cultivated, and most of it is poor, mainly owing to faulty selection of sites. Considerable areas of teak have failed. Small areas regenerated with Terminalia tomentosa, Rosewood, Pterocarpus marsupium and (experimentally) Lagerstroemia microcarpa and Flos-Reginæ, have been moderately successful up to date.

Section 2—Permanent Division of the area.

280. *Blocks.*—The Conversion Working Circle is distributed over 11 blocks in the Nilambur range, and three blocks in the Amarampalam range. In some cases whole blocks, and in others only parts of blocks are included in the working circle. The blocks are known by local names, and are only of importance in describing the approximate position of any part of the forest, and in differentiating between leased forests and State-owned forests.

281. *Compartments.*—The areas artificially regenerated between 1916 and 1927 have been divided into compartments averaging about 21 acres each. The compartments have been numbered in continuation of those of the Plantation Working Circle, and numbers 345 to 392 have already been allotted. The formation of new compartments, subsequent to conversion, will be prescribed hereafter.

Section 3—Analysis and Valuation of the Crop.

282. *Stock-mapping.*—None of the plantations, formed from 1916 onwards, has been stock-mapped. They have, however, been divided into compartments, which are shown on the 8-inch to 1 mile maps recorded in the District Forest office and Range offices. In most cases the areas, as shown in these maps, have been accepted, for the purposes of this working plan. Mr. Bourne had the natural forests mapped by eye, showing timber forest, bamboo forest and swamp. This mapping is not very accurate, but some use has been made of the results, in framing the present proposals. Most of the Nellicutta reserve was mapped by a party under the Logging Engineer, in 1924, and the topographical details supplied by them have been useful in drawing up prescriptions for work in this block.

283. *Description of compartments.*—The writer has described all the compartments regenerated from 1916 to 1927, and has prepared a simple history and description of compartments. When these plantations are stock-mapped at the next revision of the working plan, the compartment descriptions should be re-written in the more detailed form prescribed for the Plantation Working Circle.

284. *Valuations of the growing stock.*—While mapping the Nellikutta reserve, the Logging Engineer's party enumerated all trees of 1 foot diameter and upwards, at breast-height. They prepared estimates of the volume of each tree, and the totals give an average volume per acre, over 1,660 acres, of 262 cubic feet. The writer is

also indebted to the Logging Engineer, and his subordinates, for an enumeration of all trees 1½ feet diameter and upwards (at breast-height) in some 3,500 acres of the New Amarampalam reserve. In this case they estimated the merchantable height and the middle diameter of each tree. Unfortunately the enumeration lists were received too late to calculate all the volumes. The figures have, however, been used in estimating the yield from the subsidiary felling coupes, and for estimating the yield from clear-felling in part of Periodic Block I. The natural forests in the Pannengode and Walluvasseri blocks were enumerated by the Working Plans rangers, and the data obtained, though insufficient, have been used in estimating the yields to be expected from Xylia xylocarpa in the sleeper coupes.

Section 4—Allotment to Periodic Blocks.

285. *Area available for conversion.*—It would be preferable, since the forests are similar, to consider the semi-deciduous forests of the Inaccessible Working Circle along with the natural forests of the Conversion Working Circle, for the calculation of the areas to be converted annually or periodically. But since there is the possibility of the preparation of a supplementary scheme for early working in the Inaccessible Working Circle, as a result of the enumerations now in progress, the writer is obliged to treat the Conversion Working Circle as a unit in itself, and to allot areas for conversion accordingly. For want of accurate information of the extent of the forests suitable for conversion, rough estimates have to be made, relying partly on Mr. Bourne's stock-mapping. Such being the case, the calculations are made in round numbers. The total area of the Conversion Working Circle is roughly 25,000 acres. According to Mr. Bourne's stock-map the area of swamp and open swampy forest is 1,721·8 acres. Three thousand acres may therefore be excluded, as being unsuitable for conversion, owing to swampy conditions, or to the occurrence of rock outcrops. Mr. Bourne's estimate of the area of pure bamboo was 6,154·3 acres, and he prescribed that this area was to be kept for the production of bamboos for floating. A large volume of the timber traffic must eventually be diverted from the rivers to the new railway. Further, the prevalence of bamboo in more accessible private forests is almost certain to preclude the possibility of the Government forests ever supplying a bamboo pulp industry. An allowance of 3,000 acres of pure bamboo forest appears, therefore, to be ample, for the permanent production of bamboos for floating. (From the statistics recorded in Part I, paragraph 205, it appears that 3,000 acres of bamboo, in full bearing, would allow the annual felling of 3,60,000 culms. In addition too, it must be remembered that bamboos are very common in the swamps which are excluded from the calculations.) The total area of 25,000 acres, reduced by 6,000 acres (swamp and bamboo) leaves 19,000 acres available for conversion. Roughly 1,000 acres have been planted during the last working plan period. Since this area is much too small to give ten annual coupes in the regular forests of the future, and since many of the plantations are poor, it will be considered as forming part of the first periodic block, although its regeneration is completed.

286. *Conversion rotation.*—For good teak plantations, properly tended from the start, the future rotation will probably be about 60 years, unless the size requirements of the market change considerably in the meantime. For Terminalia tomentosa, Terminalia paniculata, Lagerstroemia microcarpa and Xylia xylocarpa, the same rotation will probably be adopted. (There are, already, some even-aged natural pole crops of these four species, and some, if not all of them, are to be grown artificially in the future). Of the few remaining species which are likely to be cultivated, some are slower grown and some faster than the above. Taking all these facts (they are more than surmises) into consideration, and remembering that there are already 1,000 acres of crops aged 1 to 12 years, it appears that a conversion rotation of 60 years, with approximately equal annual regeneration areas, is the most appropriate.

287. *Division into periods.*—It is convenient to make the periods correspond with the periods for which revisions of working plans are usually current. There will therefore be six periods of ten years each.

288. *Allotment to Periodic Blocks.*—The area of each Periodic Block will be approximately one-sixth of the area available, i.e., 19,000 divided by 6, or 3,200 acres (in round numbers). It is impossible (even if it were desirable) to do more, at

present, than to point out the localities in which regeneration should be undertaken in the first period. Since 1,000 acres are already planted, it is necessary to regenerate 2,200 acres in the next ten years. In accordance with recent orders of the Chief Conservator, at least 50 acres a year are to be regenerated in the poor forests of the Nilambur range, and 100 acres in the Amarampalam range are to be planted with teak in the first year, increasing the area by not less than 25 acres a year to such extent as is required to regenerate the whole of the allotted area within the ten year period. The localities in which regeneration is to be undertaken have been marked with a blue wash on the 1 inch to 1 mile scale map. It is prescribed that, before the 1st of August 1929, the District Forest Officer shall select and survey, on a scale of not less than 4 inches to 1 mile, the actual areas which are to be regenerated during the period of this plan. The surveyed sketch of areas so selected is to be sent forthwith to the Chief Conservator for approval. While there are large areas suitable for teak planting, in reasonably accessible localities, and while regeneration with species other than teak is still more or less in the experimental stage, it is prescribed that 50 acres a year shall, normally, be the maximum as well as the minimum limit in the Nilambur range. This limit may, however, be exceeded if results are particularly favourable, provided that the Chief Conservator's sanction is obtained, but there must then be a corresponding reduction in the areas to be regenerated in the Amarampalam range. The following table, based on the assumption that this limit of 50 acres a year will be osberved, shows the areas to be regenerated in the first period :—

Range.	Name of block.	Periodic Block I. Area marked on map.	Periodic Block I. Area to be regenerated by 1937–38.	Remarks.
		ACS.	ACS.	
Nilambur	Erambadam	56·0	56·0	Selected by District Forest Officer and clear-felled in 1927. To be planted with teak in 1928.
	Old Amarampalam ..	28·4	28·4	To be regenerated with species other than teak.
	Pannengode	148·0	148·0	Do.
	Pokode	478·4	267·6	To be regenerated with species other than teak excluding large areas of pure bamboo.
	Chatomhorai	122·8		
Amarampalam ..	New Amarampalam ..	1,243·0	1,700·0	One hundred and three acres felled in 1927 to be planted with teak in 1928. The balance of 1,597 acres is to be selected and mapped by the District Forest Officer before 1st August 1929, excluding swamps and areas liable to turn swampy and large areas of pure bamboo. Regeneration mainly by teak, with Hopea parviflora on such hill-tops as are not fit for teak.
	Nellicutta	1,870 3		
Total area to be regenerated			2,200·0	
Add area regenerated between 1916 and 1927 ..			1,017·1	
Grand total—Periodic Block I			3,217·1	

It remains to justify the above selection of areas allotted for regeneration. Since cultivation of crops other than teak has scarcely passed the experimental stage, most of the regeneration prescribed must be with teak. The portion of the new Amarampalam reserve which has been selected is accessible, and contains large areas which appear to be adapted for growing really good teak crops. In fact it is only necessary to exclude certain swampy areas, areas likely to turn to swamp, some patches of pure bamboo, and a few areas of shallow soil on hill-tops. The Nellicutta Reserve has been chosen for several reasons. In the first place, the existing stand of timber, of species usually extracted averages less than 250 cubic feet per acre, and most of the saleable timber is mature. Natural regeneration is scanty or lacking. Secondly, the Reserve is so well placed from the point of view of extraction that it should be possible to dispose of all species at a profit. Thirdly, considerable areas will produce teak of the finest quality, and the whole area, excluding swampy localities, and hill-tops with shallow soil, is fit for teak plantations none of which should be poorer than medium III Quality. Fourthly, the proximity of the Punnapuzha makes the whole of this block more suitable for teak planting than most of the good localities in the Amarampalam Reserve, since the profitable disposal of the early intermediate yields

has a most important bearing on the financial aspect of planting. Finally, until the Karumpuzha and Cherupuzha are bridged it is impossible to form teak plantations, elsewhere, on the scale ordered by the Chief Conservator. In the Nilambur Range, all the reasonably accessible areas which are fit for teak, have been planted in the past. Since artificial regeneration with other species is contemplated, the areas should be small, in the first instance. The areas now selected are those in which the present crop is very poor, most of the valuable timber is mature, and natural regeneration is scanty. From the financial and silvicultural points of view they should be regenerated at once. Further, the areas are extremely accessible for extraction, being very close to the railway and to the main river, and their regeneration can be most easily supervised by the District Forest Officer himself. The latter is an important factor at any time, but more especially so when new species are to be cultivated. For the sake of simplicity the method of treatment will now be described in two sections, the first for Periodic Block I and the second for the rest of the forest.

SECTION 5—PERIODIC BLOCK I—METHOD OF TREATMENT.

289. *Choice of species.*—The choice of species ought to be made for the Working Circle as a whole, but since, for the first period, the management must confine itself mainly to regeneration with teak, while evolving cheap and efficient methods of cultivating other species, it is necessary to make the choice particular to Periodic Block I. Teak shall be grown, in 1928, in the two areas selected by the District Forest Officer and clear-felled in 1927-28. In the remainder of Periodic Block I in the Amarampalam Range, teak shall be grown on all suitable areas, and Hopea parviflora shall be introduced, under favourable shade conditions, on hill-tops where the soil is too shallow for teak. In the Nilambur Range, the remaining natural forests in Old Amarampalam are suitable for regeneration with Rosewood on the higher ground, and with Terminalia tomentosa on the lower. The possibility of raising about two acres of teak, on the alluvium in the southern corner of this area, should be considered. The choice of species in the Pannengode and Pokode blocks will be decided by the Conservator. It is definitely prescribed that regeneration shall proceed at the rate of 50 acres a year, and that each area taken up must be left fully stocked with *some* valuable species by the end of the second year. It is desirable to try a number of species, and cheap and efficient methods of formation must be evolved. Provided Rosewood and Lagerstroemia microcarpa are kept off the very shallow soils, practically all the soil in the areas allotted is suitable for the following species:—Rosewood, Lagerstroemia microcarpa, Terminalia paniculata, Artocarpus integrifolia and hirsuta, Hopea parviflora, Swietenia macrophylla, and Xylia Xylocarpa. (There is no object in raising the last species artificially, for it can be regenerated naturally in many parts of the natural forest.) In the small areas where the drainage is poor (usually near paddy flats) Terminalia tomentosa and paniculata will be suitable. If regeneration has to be undertaken in the Chatomborai block, Xylia xylocarpa will be chosen, and it will be raised by selecting areas where the admixture of bamboo is not considerable, opening the canopy, and getting natural regeneration. (The choice of Xylia is incontestable. The soil is really too poor for any other tree species; natural regeneration can be obtained; and no stump-fee is payable on this species under the terms of the Chatomborai lease.)

290. *Silvicultural systems.*—Clear-felling with artificial regeneration will be the system of forming teak woods. Other species will be introduced artificially, both after clear-felling, and under various kinds of shelterwoods. Natural regeneration of Xylia xylocarpa under a shelterwood is suggested in certain areas.

291. *Selection of areas for regeneration.*—The District Forest Officer must personally select the areas for regeneration with different species. The areas allotted in the Amarampalam Range contain deep disintegrated gneiss on the lower slopes of practically all the hills. In several places (especially in New Amarampalam) these deep gneiss soils are found right up to the tops of the hills. In other parts, particularly in Nellicutta, the upper slopes of the hills consist of deep disintegrated laterite (mixed with gneiss in varying degrees) with rather shallow laterite on some of the hill tops, though not on all. In Nellicutta there are also large areas of deep alluvium. The latter will produce the best teak growth, wherever the drainage is

sufficient. Deep disintegrated gneiss, deep disintegrated laterite, and a mixture of both, are all suitable for teak. For teak planting in this Range, therefore, the District Forest Officer must exclude swampy areas, areas liable to turn swampy after felling, and pure bamboo areas of about 20 acres or more. (The latter provision is made, more with a view to save expense on clearing, than for any other reason.) On and near hill tops, where the soil is too shallow for teak, Hopea parviflora shall be raised, in all places where the shade conditions are favourable. The introduction of Hopea is prescribed, partly because it is, in itself, a very valuable timber, partly, to provide a future underwood in the teak plantations down the hills, and partly to give the management of the future the option of changing the species naturally, when the time comes for felling the teak. The area to be regenerated in Amarampalam Range, in the 10-year period, is 1,700 acres. Roughly 100 acres are cleared for regeneration in 1928. The area for regeneration in 1929 should be in the block selected in the New Amarampalam Reserve near Kanhirakadavu, since it is unlikely that arrangements can be made, early enough, to organize labour for Nellicutta. This being so, only about 130 acres can be taken up in 1929, since the floating possibility of the Karumpuzha is limited. This leaves 1,470 acres for regeneration in the next 8 years, and 180 to 185 acres should be taken up annually. If so much cannot be undertaken at once, the Chief Conservator's orders about increasing the area, by at least 25 acres a year, must be observed. The scene of regeneration must be moved to Nellicutta in 1930, and operations will continue in that block until all areas suitable for teak and Hopea have been taken up. This is estimated to take at least five years, and may take longer. By that time it is expected that the Karumpuzha and Cherupuzha will be bridged, and that large areas in New Amarampalam can be felled and regenerated For raising miscellaneous species in the Nilambur Range, the whole of the areas allotted in Old Amarampalam and Pannengode shall be taken up. In Pokode, pure bamboo areas extending to 15 acres and upwards shall be excluded. Chatomborai has only been added in case the presence of pure bamboo in Pokode may be found to prevent the regeneration of the full 500 acres in this and the first three areas allotted. If Chatomborai has to be regenerated pure bamboo areas will be excluded, and natural regeneration of Xylia xylocarpa will be raised in the remainder, as already stated. Fifty acres a year shall be regenerated in the Nilambur Range. If it appears advisable, as the management's knowledge of growing species other than teak increases, there is no objection to taking up 100 acres in one year, stocking them fully, and confining the regeneration of the next year to the replacement of casualities.

292. *Regulation of the yield.*—The yield will be regulated by area, and will depend upon the area taken up for regeneration each year, and upon the amount of shelterwood left for Hopea parviflora and other miscellaneous species. An estimate of the yield during the first period will be found in the tabular statements of operations.

Prescriptions.

293. *Marking and felling.*—Whether felling is to be done by the department or by contractors, all the saleable trees, which are to be extracted, shall be serially numbered, and recorded in an enumeration register, which will also contain the breast-height girth measurement, and an estimate of height, middle girth and volume. In areas which have to be cleared for regeneration, felling and extraction of the saleable timber must be completed by the end of October. The stump of each tree felled shall be chiselled with the serial number of the tree. Logging, measurement, classification and checking shall be done as prescribed for felling in the Plantation Working Circle. When removing shade trees which stand over Hopea parviflora or other species regenerated under shade, the trees shall be felled with the minimum of damage to the regeneration beneath them.

294. *Formation of teak plantations.*—It is very important to get a fierce burn over the whole area on which teak is to be introduced. Extraction of timber must be completed expeditiously, and the whole of the unsaleable material must be felled by the end of December at the latest. Where bamboos occur, they shall be cut first, and unsaleable trees shall be felled afterwards. The latter then fall on the former, and make compact heaps for burning. Burning shall be commenced when

the area is thoroughly dry, between the middle and the end of February. Since there will be no existing compartment lines, it will be necessary to lay out guide-lines, intersecting at right angles, before staking the area. The espacement will be 6′ × 6′. Bamboo stakes about 2½ feet long shall be used. Staking must be completed before the middle of April. The actual method of formation depends upon the possibility of inducing cultivators to clear and burn the area, in return for the privilege of being allowed to raise a crop of paddy. In any event, the actual regeneration must be done departmentally. If 'ponam' regeneration is possible; one-year old stumps will be required and dry nurseries must be sown early in July of the year before formation. They will require little or no watering, if the soil is 'ærated' regularly. Nurseries shall be made as described in the last chapter. They must be kept free of weeds. In Travancore, where the 'ponam' method is practised with complete success, it has been found that stumps no thicker than the forefinger give the best results, and such stumps are obtained by congestion of the seedlings in the nurseries. Stump-planting should commence when the monsoon starts. The seedlings must be pruned, leaving two to three inches of stem and about 9 inches of root. Such stumps are to be planted in vertical crow-bar holes, of exactly the same depth as the roots are long, that is to say, the collum must be exactly at ground level, and there must be no space between the end of the stump and the bottom of the crow-bar hole. The hole must be closed by plunging the crow-bar into the earth, at an angle, about six inches away from the stump plant, and pulling it towards the plant, packing the soil so tightly that the plant cannot be pulled out by hand without difficulty. The paddy should be weeded during the monsoon, and it is an advantage, though not essential, to keep it pressed back from the teak plants. Such casualities as occur shall be replaced during the monsoon. As soon as the paddy ears are harvested, the stalks must be uprooted and laid in lines along the contours, to prevent wash. Any weeds on the area must be uprooted at the same time, and surplus teak shoots must be cut, leaving one good shoot on each stump, at ground level. If weeds again become bad during the first year it will probably be sufficient to cut them with knives. Should 'ponam' regeneration be found impracticable, all the regeneration operations shall be done departmentally. Direct-sowing, on natural forest clearings, has recently been found quite as efficient as planting, and considerably cheaper. It should, therefore, be continued, unless good reasons for reverting to planting are brought forward. Expensive loosening of the soil is unnecessary in the Conversion Working Circle. It will be sufficient to loosen the earth to a depth of five or six inches at the time of sowing, using any implement that is found suitable. (A kind of knife with a long haft is used at Mount Staurt.) In other respects, the sowing shall be done as described for the Plantation Working Circle. Casualties will be replaced, utilizing surplus seedlings from stakes where there are two or more, and supplementing them by small seedlings from dumps, and from rough and ready nurseries. In the event of a reversion from sowing to planting, nurseries shall be made as described in the previous chapter. Preparation of the soil sould be limited to loosening it to a depth sufficient to take the plant. In fact it will probably be good enough to plant small seedlings in holes made with a pointed stick, as is done with success elsewhere. Whatever the method of regeneration, collection of good and sufficient seed, early formation, and 100 per cent stocking in the first year, are the factors which make for success, and close supervision is absolutely essential. If any areas turn swampy after felling, they must be stocked with Terminalia tomentosa by the middle of the monsoon. The first weeding, in areas regenerated without the field crops, will be done in July, as prescribed for the Plantation Working Circle. The second weeding shall be done in September. On strips four feet wide the weeds shall be uprooted, by digging the soil (using the most suitable tools). The loose earth shall be shaken off their roots, and the weeds shall be laid in lines, roughly parallel to the contours in hilly country. If a third weeding is necessary, to free the teak from suppression, grass knifing will be sufficient. In both weedings, all adventitious growth of tree species must be retained, unless it is actually threatening the teak. Bamboo regrowth shall be cut repeatedly, as it appears.

295. *Second year tending of teak plantations.*—About April of the second year, divided stems and stout side branches shall be pruned, as in the Plantation Working Circle. Damaged stems shall be cut back. A single weeding will be sufficient in

normal plantations, and it shall be done before the weeds flower, in July. The actual manner of executing this weeding is left to the local officers. Grass knifing will probably be sufficient in good areas, but clean weeding may be required where the growth happens to be poor. As in the first year weeding, as much natural growth of tree species as possible must be retained. Replacement of casualties in the second year should be unnecessary, but will be undertaken if it is required. The total cost of formation of teak plantations (first and second year's work) should vary between Rs. 45 and Rs. 52 per acre. If 'ponam' regeneration succeeds, the above figures should be reduced by Rs. 20 to Rs. 25 per acre—the estimated cost of clearing and burning.

296. *Introduction of Hopea on hill tops adjoining teak plantations.*—In the Amarampalam Range, on hill tops where the soil is too shallow for teak, Hopea parviflora shall be introduced, at an espacement of 9′ × 9′, wherever the shade conditions are favourable. In the localities chosen for regeneration, such shallow soil is unlikely to exceed ten per cent of the whole regeneration area. The areas shall be selected before any marketable timber is felled, since it will be necessary to retain the whole, or most of the existing stand, as shade for the young Hopea. The Hopea will be introduced as prescribed for the Plantation Working Circle, and casualties must be replaced in the second and third years.

297. *Formation of crops of miscellaneous species.*—With the exception of the clearing in Erambadam, and possibly a couple of acres in Old Amarampalem, the areas allotted for regeneration in the Nilambur Range are unsuitable for teak. The experiments of the past have shown that various other species can be raised artificially, and the time has now come for the management to practise regeneration on a moderate scale, and to evolve cheap and efficient methods. The work will be absorbing silvicultural interest, and it is believed that better results will be obtained, if the District Forest Officer is allowed a more or less free hand, than if rules, which at the best can only be tentative, are prescribed. It is therefore laid down that selection of areas, choice of species, and methods of regeneration shall be decided by the District Forest Officer subject to the approval of the Conservator. Full stocking in the first year must be obtained, if, possible, and it is incumbent on the management to leave each area fully stocked by the end of the second year. (This permits the use of a different species in the second year, where it is found impossible to get success with any species originally chosen). Several suggestions may be made. In the first place the financial aspect of the formation of crops of various valuable species, in the small areas allotted, should not be the main consideration, since there are very large areas which will eventually have to be treated by such methods as prove successful in the small areas now under consideration. This being the case, the fencing of clear-felled areas need not be considered too expensive, provided success is obtained, for it is almost certain that no such protection will be required when really large clearings are made. It is desirable to try a number of species, in preference to choosing only one or two whose cultivation is considered to be easy. Pure crops are not desirable, unless the species chosen are such as maintain the productivety of the soil. Mixtures by groups should be tried, and natural mixtures can and should be obtained, by encouraging such species as Xylia xylocarpa which appear amongst artificial crops of other species. The main objection to artificial regeneration under a shelterwood is the difficulty of supervision by the officer in charge. This objection scarcely applies in the small areas now under consideration, but it is bound to influence the choice of methods, when large areas are taken up. It is therefore important to make an early attempt to grow several species in the open. An intimate mixture of rosewood and Lagerstroemia microcarpa (the latter to draw up the former) promises success, under the 'ponam" method of regeneration. Terminalia paniculata and Artocarpus integrifolia are other species which deserve a trial, in conjunction with field crops. Terminalia tomentosa should be grown in swampy areas. In all 'ponam' regeneration on small clearings, some form of protection from cattle and deer will be required, both for the sake of the grain and the tree crops. An espacement of 7 feet × 7 feet seems appropriate, since this would give room for good grain crops, and still allow the clearing of small circles of paddy round each tree plant. Remembering the necessity for evolving methods suitable to large clearings, the

ponam' method should not be discarded without real, sustained efforts to make it a success. Regeneration under shade should be undertaken in some areas, irrespective of the success or otherwise of 'ponam,' and may be undertaken in all, if the 'ponam' method fails, or if it succeeds, but is thought to be too expensive on a scale which requires special protection from animals. Where the shade is moderately heavy, an espacement of 9 feet × 9 feet will probably be suitable. Excluding areas of pure bamboo, it is believed that the whole area allotted can be regenerated under shade, with the following species :—Hopea parviflora in all well-drained localities where shade conditions are favourable ; Swietenia macrophylla, in similar localities under moderate shade which is insufficient for Hopea ; rosewood (or Lagerstroemia microcarpa) in well-drained localities where the soil is not very shallow, under the shade left after extracting marketable timber ; Xylia xylocarpa on any laterite soil where there are sufficient seed bearers, by natural regeneration, after opening the canopy ; Terminalia tomentosa in ill-drained localities, under the shade left after extracting marketable timber. The above list is not exhaustive but it includes sufficient species to regenerate every type of locality in the areas allotted, without mentioning any species whose experimental cultivation has not already been attended with a considerable measure of success. (Suitable ways of raising the different species have been suggested in paragraph 182 of Part I.) The amount and nature of tending, during formation, is left to the management. In the case of Hopea parviflora, casualties must be replaced in the second and third years.

298. *Tending subsequent to the establishment of the crops.*—Many parts of the recent teak plantations of Periodic Block I have been, and are being spoilt by bamboo. Bamboos must be cut, as often as necessary, in the plantations already formed, and in those formed during the ensuing period. Climbers shall be cut at the same time. Crops of other species shall be tended as required. Their exact requirements cannot be anticipated. In all regenaration areas, stems damaged by animals or by borers shall be coppiced, at least in the first two years.

299. *Thinning.*—The teak plantations shall be thinned as described in paragraph 244 above. Since all the plantations will be young, it should be possible to get the ideal espacement from the start Climber cutting, removal of threatening bamboos, etc., shall be done at the time of thinning, as prescribed for the Plantation Working Circle. The writer has estimated the years in which thinning will be required, but his programme will be modified* by the District Forest Officer subject to the prior approval of the conservator to such extent as is found necessary. In the few places where other species have been introduced in the plantations of 1916 to 1927, such thinning and tending as each crop requires, shall be undertaken when thinning the adjacent teak areas In the case of areas to be regenerated with miscellaneous species from 1928 onwards, it is unlikely that any thinning will be required in the first period, so none is prescribed.

Section 6—Conversion Working Circle exclusive of Periodic Block I—Method of Treatment.

300. *General.*—The prescriptions for treating the rest of the forest have three main objectives, namely :—(*a*) the removal of mature and overmature timber, to save it from being lost, (*b*) the improvement of the trees left standing, so as to get the best possible yield when their time comes for final felling and (*c*) the conversion to even-aged woods without artificial regeneration of all areas where the existing crops lend themselves to such treatment. The first object will be realized by subsidiary fellings, with fixed girth limits. The second will be attained by opening the canopy in the course of subsidiary fellings, by avoiding breakage of standing trees during these fellings, and by cutting climbers on the valuable trees which are left. The last object will be realized by carefully conducted improvement felling and climber cutting, as prescribed hereafter. For the distribution and control of the above operations, the rest of the forest, with the exception of the poorest parts, is divided into 21 annual coupes. In the poorest forests, sound, mature trees are so scattered that it is extremely doubtful whether the subsidiary feelings, prescribed for the better forests, would pay, especially as the leads are often long. They have, therefore, been divided into ten annual coupes for the extraction of mature Xylia xylocarpa, in the form of sleepers. Such operations are certain to be remunerative, and and will save a considerable amount of timber from decay, besides assisting the pole

growth of Xylia in the immediate vicinity of the trees felled. For purposes of description, the operations in the better forests will be called ' subsidiary fellings, " and the coupes will be marked with roman numerals The operations in poorer forests (which are of small extent) will be called ' Xylia sleeper feelings, " and the coupes will be indicated by Arabic numerals.

301. *Period of working.*—Since the area of the irregular forests will be gradually reduced, by conversion to even-aged woods, there is no question of fixing a felling cycle, and deciding on a regular rotation of coupes. The better forests should be worked over, within 15 years or so, for the removal of mature timber, but it is thought that such a period is too short for the efficient execution of the operations prescribed. Twenty years is fixed as being a suitable period for the conduct of these operations. The total area of the poor forests is small, and they can easily be worked over, in the next ten years.

302. *Division into annual coupes.*—There is so much variation in volume per acre, from place to place, that although about 3,500 acres of the better forests have been enumerated, it is impossible to lay out coupes of similar yield capacity, with any pretence of accuracy. Coupe I is being worked in 1927–28, as an advance prescription of this working plan. Coupes II to X are intended to give a much larger average yield than coupes XI to XXI, since the areas to be regenerated in Periodic Block I will be less, by about 100 acres a year, than the regeneration areas of the second period (See paragraph 288). Apart from this, it is hoped that the variations in yield, between one coupe and another, will not be such as to upset the market, or to involve difficulties of administration. (Coupes XII to XXI have been roughly marked, without the help of any enumerations in or near them. It will probably be necessary to revise their respective sizes at the next revision of the working plan) The Xylia sleeper coupes have been simply made of such size and location as to allow of easy working, and the estimated outturn of each coupe is based on enumeration of a small area in Pannengode and Walluvasseri. The estimate does not pretend to be accurate, but it is believed to be on the conservative side. In all the coupes, both for subsidiary fellings and Xylia sleeper fellings, natural features have been used as boundaries, wherever possible.

303. *Subsidiary fellings.*—Since practically all the forests are ultimately to be converted to even-aged woods, the exploitable girths, for the different species, have been fixed solely with the object of saving all good timber which might decay, before fellings are likely to come round again. The following are the sizes of exploitability fixed for the most valuable species :—

Serial number and Species.	Girth at breast-height.
1. Xylia xylocarpa ...	$5\frac{1}{2}$ feet
2. Teak ...	6 ,,
3. Rosewood ...	7 ,,
4. Terminalia paniculata ...	7 ,,
5. Terminalia tomentosa ...	7 ,,
6. Lagerstroemia microcarpa ...	7 ,,
7. Pterocarpus Marsupium ...	7 ,,
8. Artocarpus hirsuta ...	7 ,,

Subject to the *proviso* that the forests may not be opened out to such a degree as to cause deterioration of the soil, all sound trees of the above valuable species, which have attained or exceeded the girth noted against each, shall be felled. Dead trees of any species, whether standing or fallen, shall also be extracted, provided they can be sold at a profit. In the event of some of the less valuable species (excluded from the above list) being accepted for railway sleepers in the future, or, becoming saleable at good prices for other purposes, they may be included, under proper sanction. The felling shall be conducted with the least possible damage to the crop which is to be left. It is essential that all timber be brought to the sale depots within 18 months of felling. Careful regulation will therefore be required, to keep the annual outturn within the extraction possibility, until such time as extraction facilities have been improved. The exploitable trees, as described above, shall be marked and numbered, on stem and stump, before felling. Marking should be done by a Ranger. The breast-height girth of each tree shall be measured. The height of exploitable bole, and the girth in the centre of the exploitable bole shall be estimated. These data shall be recorded in an enumeration register, and the anticipated volume shall be calculated. The marking shall be passed by the District Forest Officer or other-

gazetted officer, who shall exclude any trees he considers necessary to retain, for soil protection. The rules prescribed in paragraph 293 for marking, classifying and recording the outturn, shall be observed. If the whole of any coupe is not worked in the year to which it is allotted, the balance shall be worked in the following year, before commencing the new coupe.

304. *Climber cutting after subsidiary fellings.*—Following the subsidiary fellings of each year, the whole coupe shall be traversed, and climbers shall be cut on all standing trees and poles of valuable species.

305. *Conversion by means of improvement fellings.*—Scattered throughout the better forests there are areas, of varying extent, in which poles of superior species are present, in sufficient number, to make a reasonably complete, regular crop. These areas will be found in the course of marking the subsidiary fellings in each coupe. Provided the extent of each is not less than five acres, they shall be subjected to special improvement fellings, while the subsidiary fellings are in progress. Marking must be done by the District Forest Officer himself. The object of these fellings is to leave more or less regular pole crops of all the valuable species which are present in each area. The saleable trees of the overwood shall be felled and extracted. Unsaleable trees of the overwood, which are hampering the development of the poles, shall be girdled, if this is found efficient, and cheaper than felling. Otherwise they shall be cut down. Useless softwoods, of pole size, shall similarly be girdled or felled, unless they are required in the canopy and are not shading saplings or regeneration of important species. Any bamboos which are likely to injure the pole crop shall be cut. All fellings shall be conducted with the least possible damage to the pole crop. Damaged poles shall be cut back, if they are required in the canopy. Such further thinning as is silviculturally necessary shall be undertaken, amongst the valuable species of the pole crop. Finally, all climbers shall be cut, on the poles and saplings which are retained.

306. *Xylia sleeper fellings.*—The poorer forests of the Nilambur Range have been divided into ten coupes for the extraction of Xylia sleepers. In these forests, a girth of five feet at breast-height appears to indicate maturity. In the coupe of the year, therefore, all sound Xylia xylocarpa trees, of and above five feet girth at breast-height, shall be marked on stem and stump, as prescribed for subsidiary fellings. Sound, dead trees, standing or fallen, shall also be marked for extraction, if they are big enough to give one or more sleepers. The marking shall be done by a Ranger who must prepare an enumeration register as prescribed in paragraph 303. Marking shall be passed by a gazetted officer. The general method of exploitation will be to saw the trees into sleepers, in the forest, and to carry the sleepers to the nearest point for floating or carting. In the most accessible areas, however, it will probably be more profitable to extract the timber in the log. The outturn shall be recorded, as prescribed in paragraph 303. The agency of exploitation is left to the management to decide. Departmental conversion and extraction, contract conversion and extraction, or sale standing, are all possible. If the marked trees are sold standing, adequate precautions against theft must be taken. Each tree should be converted into the maximum number of sleepers of the different gauges.

307. *Regulation of the yield.*—As in Periodic Block I, so in the rest of the forest, the yield will be regulated by area, and will be limited to the annual coupe prescribed for working each year. Until extraction facilities are improved, a volume check also must be observed in the case of subsidiary fellings, in order to limit the outturn to the extraction possibility (see paragraph 303). Estimates of the yield, during the first period, will be found in the tabular statement of subsidiary and Xylia sleeper fellings. As regards the subsidiary fellings, it is unlikely that yields in excess of the estimates in column 4 of paragraph 314 can be extracted, until existing facilities are improved. As a further automatic safeguard it is definitely prescribed that, at no time, shall a greater volume of timber from subsidiary fellings than 160,000 cubic feet be lying unremoved within the limits of Amarampalam Range.

Section 7.—Prescriptions common to the whole Working Circle.

308. *Formation and maintenance of compartments.*—The areas regenerated between 1916 and 1927 have been divided up into compartments and numbered from 345 to 392. The compartment boundaries will be kept clear, and the boards at the corners will be maintained, and replaced as required. The compartment numbers should be engraved on the boards, in addition to painting. The areas artificially regenerated each year, shall immediately be subdivided, by means of

interior lines or inspection paths, into suitable compartments averaging 25 acres each, and shall be numbered with boards. In big clearings, such as the proposed teak plantations, the division into compartments can most conveniently be done during lining, using guide lines which intersect at right angles, and suitable contour paths, for this purpose. Areas of ten acres and upwards, which are converted by means of improvement fellings, shall be divided into compartments of similar size, and shall be demarcated by cleared lines; areas of less than ten acres shall be marked in such less expensive way as the management may decide, provided the position of each area is unmistakably fixed and mapped, and that a compartment number is allotted.

309. *Fire protection.*—The compartment boundaries in Periodic Block I shall be maintained as fire-lines, and shall be cleared and patrolled, as prescribed for the Plantation Working Circle (paragraph 266). In the rest of the forest, the existing system of natural forest fire-lines shall be maintained, and shall be cleared and patrolled annually as is done at present. In the larger areas converted by improvement fellings, whose demarcation has been prescribed in the last paragraph, the lines shall be cleared and patrolled, as in the case of areas regenerated artificially.

Section 8.—Tabular Statements of Operations.

310. *General.*—In the following paragraphs, an attempt has been made to lay down an annual programme of the operations to be undertaken in the Conversion Working Circle. The programme must not be considered complete. It is likely to develop as knowledge and experience are gained, especially as regards tending in crops of species other than teak, and freeing teak from suppression by bamboo. The estimates of yields are based on most inadequate data, and on surmises which may or may not prove to be correct, but it is believed that, on the whole, the estimates are on the conservative side. The first three tables refer to the operations required in Periodic Block I. The fourth table contains the annual coupes in which subsidiary fellings, conversion by means of improvement fellings, and climber-cutting operations are to be undertaken. The last table contains the programme of Xylia sleeper fellings.

Periodic Block I.

Plan of final felling.

311.

Year of working.	Range.	Estimate of area to be taken up.	Estimated total volume of saleable timber on each area.	Estimated volume of saleable timber to be left as shelterwood beyond the working plan period.	Total estimated volume to be removed from each area in the working plan period.
		ACS.	C. FT.	C. FT.	C. FT.
1928–29	Nilambur	50	15,000	5,000	10,000
	Amarampalam	130	39,000	3,900	35,100
1929–30	Nilambur	50	15,000	5,000	10,000
	Amarampalam	180	54,000	5,400	48,600
1930–31	Nilambur	50	15,000	5,000	10,000
	Amarampalam	180	54,000	5,400	48,600
1931–32	Nilambur	50	10,000	3,000	7,000
	Amarampalam	180	54,000	5,400	48,600
1932–33	Nilambur	50	10,000	3,000	7,000
	Amarampalam	180	54,000	5,400	48,600
1933–34	Nilambur	50	10,000	3,000	7,000
	Amarampalam	180	54,000	5,400	48,600
1934–35	Nilambur	50	10,000	3,000	7,000
	Amarampalam	190	57,000	5,700	51,300
1935–36	Nilambur	50	10,000	3,000	7,000
	Amarampalam	190	57,000	5,700	51,300
1936–37	Nilambur	50	10,000	3,000	7,000
	Amarampalam	190	66,500	6,650	59,850
1937–38 *	Nilambur	80	16,000	5,000	11,000
	Amarampalam	240	96,000	9,600	86,400
	Total	2,370	706,500	96,550	609,950

* The felling of 1937–38 is preparatory to the regeneration of 320 acres in the first year of the second period.

Periodic Block I.

Plan of formation.

312.

Year of working.	Nature of operation.	Locality to be worked.	Area in acres.
			ACS.
1928–29	Formation and first year tending.	Erambadam .. .. Mundakadavu	56·0 103·0
	Second year tending ..	Old Amarampalam, 1926 clearing .. .. Chorlipatti, 1927 clearing .. .. .. Mundakadavu, 1926 clearing .. .. Mundakadavu, 1927 clearing .. .. Vallikal, 1926 clearing	34·5 24·7 92·0 4·1 101·0
1929–30	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (Kanhirakadavu) ..	50·0 130·0
	Second year tending ..	Erambadam, 1928 area .. .. .. Mundakadavu, 1928 area	56·0 103·0
1930–31	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (Nellicutta)	50·0 180·0
	Second year tending ..	Nilambur Range, 1929 area .. .. Amarampalam Range, 1929 area	50·0 130·0
1931–32	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (Nellicutta) ..	50·0 180·0
	Second year tending ..	Nilambur Range, 1930 area .. .. Amarampalam Range, 1930 area	50·0 180·0
	Third year tending ..	Hopea areas formed in 1929	..
1932–33	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (Nellicutta) ..	50·0 180·0
	Second year tending ..	Nilambur Range, 1931 area .. .. Amarampalam Range, 1931 area	50·0 180·0
	Third year tending ..	Hopea areas formed in 1930	..
1933–34	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (Nellicutta) ..	50·0 180·0
	Second year tending ..	Nilambur Range, 1932 area .. .. Amarampalam Range, 1932 area	50·0 180·0
	Third year tending ..	Hopea areas formed in 1931	..
1934–35	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (Nellicutta) ..	50·0 180·0
	Second year tending ..	Nilambur Range, 1933 area .. .. Amarampalam Range, 1933 area	50·0 180·0
	Third year tending ..	Hopea areas formed in 1932	..
1935–36	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (probably Nellicutta)	50·0 190·0
	Second year tending ..	Nilambur Range, 1934 area .. .. Amarampalam Range, 1934 area	50·0 180·0
	Third year tending ..	Hopea areas formed in 1933	..
1936–37	Formation and first year tending.	Nilambur Range .. .. Amarampalam Range (probably Kanhirakadavu).	50·0 190·0
	Second year tending ..	Nilambur Range, 1935 area .. .. Amarampalam Range, 1935 area	50·0 190·0
	Third year tending ..	Hopea areas formed in 1934	..
1937–38	Formation and first year tending.	Nilambur Range .. . . Amarampalam Range (Kanhirakadavu) ..	50·0 190·0
	Second year tending ..	Nilambur Range, 1936 area .. .. Amarampalam Range, 1936 area	50·0 190·0
	Third year tending ..	Hopea areas formed in 1935	..

Periodic Block I.

313. Plan of thinning.

Year of felling.	Name of block or range and year of plantation.		Number of compartment where already allotted.	Area in acres.
1928–29	Karumpoya	1919 B	354 355	19 2 13·2
1929–30	New Amarampalam	1916	345	3·0
	Do.	1917	346 347	21·8 5·0
	Do.	1918	348	7·4
1930–31	Walluvasseri	1924 A	388	20·0
	Karumpoya	1923	364 365 366 367	14·0 21·4 18·9 20·9
1931–32	Kanakuth	1920	385	39·9
	Do.	1923	386 387	26·7 21 1
	Walluvasseri	1925	390	54·4
	Karumpoya	1920 B	358	15·0
	New Amarampalam	1924 A	368 369	23·0 18·0
	Do.	1924 B	370 371	16 0 14·5
	Karumpoya	1924 C	372	18·0
	Karumpoya and New Amarampalam	1925	373 374	34·2 25·0
1932–33	Old Amarampalam	1926	391 392	8·2 26·3
	New Amarampalam	1919 C	349	12·5
	Karumpoya	1920 A	356 357	31·1 20·6
	Do.	1921–22	359 360	33·5 54·5
	New Amarampalam	1921	361 362 363	8·9 1·8 11·8
	Karumpoya	1926	378 379 380 381	23·0 28·0 23·0 27·0
1933–34	Karumpoya	1919 A	350 351 352 353	9 0 12·5 15·5 15·2
	Do.	1919 B	354 355	19·2 13·2
	New Amarampalam	1926	375 376 377	22·0 34·5 35·5
	Do.	1927	384	4·1
	Karumpoya	1927 A	382	11·5
	Do.	1927 B	383	13·2
1934–35	Erambadam	1928	..	..
	New Amarampalam	1928	..	103·0
	Do.	1929	..	130·0
	Do.	1916	345	3·0
	Do.	1917	346 347	21·8 5·0
	Do.	1918	348	7·4
1935–36	Amarampalam range	1930	..	180·0
1936–37	Kanakuth	1920	385	39·9
	Do.	1923	386 387	26·7 21·1
	Walluvasseri	1924 A	388	20·0
	Karumpoya	1923	364 365 366 367	14·0 21·4 18·9 20·9
	Amarampalam range	1931	..	180·0

Periodic Block I—cont.

Plan of thinning—*cont.*

Year of felling.	Name of block or range and year of plantation.			Number of compartment where already allotted.	Area in acres.
1937-38	Walluvasseri	1925		390	54·4
	Karumpoya	1920	B	358	15·0
	New Amarampalam	1924	A	368	23·0
				369	18·0
	Do.	1924	B	370	16·0
				371	14·5
	Karumpoya	1924	C	372	18·0
	Karumpoya and New Amarampalam	1925		373	34·2
				374	25·0
	Amarampalam range	1932		..	180·0

NOTE.— In most cases the areas given against compartments are the total areas and therefore include failed areas. In a few instances, where it is unlikely that there will be any trees worth tending, the approximate areas of failures have been deducted.

Conversion Working Circle exclusive of Periodic Block I.

Plan of subsidiary felling, improvement felling, and climber cutting.

314

Year of working.	Number of coupe.	Area in acres.	Estimated volume of the yield.	Remarks.
			C. FT.	
1928-29 ..	Unworked area of I.	Not known at time of writing.	30,000	No improvement felling nor climber cutting was undertaken in Coupe I in 1927-28. These works should be done in 1928-29, as well as completing the subsidiary fellings, before commencing Coupe II.
	II	520	81,000	
1929-30 ..	III	960	84,000	
1930-31 ..	IV	602	84,000	
1931-32 ..	V-A	378	82,000	
	V-B	64		
1932-33 ..	VI	450	82,000	
1933-34 ..	VII	695	90,000	
1934-35 ..	VIII	640	89,000	
1935-36 ..	IX	864	1,12,000	
1936-37 ..	X	570	91,000	
1937-38 ..	XI	505	62,000	
		Total ..	8,87,000	

Conversion Working Circle exclusive of Periodic Block I—cont.

Plan of Xylia sleeper fellings.

315.

Year of working.	Number of coupe.	Approximate area in acres.	Estimated volume of the outturn after conversion.
1928-29	1-A	78	6,700
	1-B	90	
1929-30	2	280	11,200
1930-31	3	290	11,600
1931-32	4	540	21,600
1932-33	5	760	30,400
1933-34	6	730	29,200
1934-35	7	640	25,600
1935-36	8	440	17,600
1936-37	9	510	20,400
1937-38	10	235	9,400
		Total ..	1,83,700

SECTION 9.—CONTROL.

316. *General.*—The control forms peculiar to the Conversion Working Circle will be the same as those prescribed for the Plantation Working Circle, namely Control Book, Record of Works and Compartment History. Similar maps will also have to be maintained.

317. *Control Book.*—The Control Book will compare the actual exploitation of each year with the prescriptions of the working plan. Final fellings, subsidiary and improvement fellings, and Xylia sleeper fellings will all find a place in this form. Sample entries will be found in Appendix A.

318. *Record of Works.*—All works other than the fellings named above, which are peculiar to the Conversion Working Circle, will be controlled in the Record of Works. Entries will be made in a similar form to the samples given for the Plantation Working Circle in Appendix A.

319. *History and description of compartments.*—The writer has prepared a history and description of all the compartments formed from 1916 to 1927. Since none of these plantations has been stock-mapped, a simple form of description has been adopted. These forms shall be filed in the form of a loose leaf note-book, and shall be kept up to date by posting brief details of each year's history. Similar forms shall be prepared by the District Forest Officer for the compartments formed each year, and shall be added to the file, and kept up to date. A sample form is given in Appendix A.

320. *Maps.*—The areas which are converted each year shall be surveyed and mapped on the scale of 8″—1 mile. Compartment boundaries will be marked, and areas regenerated with various species shall be distinguished. On the 1″—1 mile map, the District Forest Officer must mark the areas in which subsidiary fellings and Xylia sleeper felling are carried out each year. Fire maps shall be maintained as prescribed for the Plantation Working Circle. In the case of natural forests, burnt areas (both in the Conversion and Inaccessible Working Circles) shall be marked on the 1″—1 mile map. Burnt areas in plantations shall be marked on a set of 8″—1 mile maps maintained as fire maps.

CHAPTER IV.—WORKING PLAN FOR THE INACCESSIBLE WORKING CIRCLE.

321. *Area, situation and brief description.*—The Inaccessible Working Circle is in the east of the New Amarampalem Reserve and comprises 48,299 acres which are inaccessible for the economic working of timber by the existing means of extraction, and the present system of communications. This Working Circle stretches from the top of the Nilgiris, down to the limits of the Conversion Working Circle near the foot of the ghats. It consists of evergreen and semi-deciduous forests, high grass lands, and precipices, and contains the head waters of the Karumpuzha, and some of the head waters of the Punnapuzha.

322. *Valuation of the growing stock.*—In the season 1926-27 a party working under the orders of the Logging Engineer, Madras, commenced the mapping and enumeration of the forests, and this work is proceeding.

323. *Prescriptions.*—The Inaccessible Working Circle will not be worked under the prescriptions of this working plan, except as part of the Minor Forest Produce and Bamboo Working Circles. If the enumerations show that extensive timber operations are desirable in the near future, a supplemental working plan must be prepared to provide for the exploitation and regeneration of the forests. While there is so much scope for expansion of conversion in the far more accessible forests of the Conversion Working Circle, there seems no point in taking this work higher up the hills, where costs will be so much greater and labour difficulties more acute. It is probable, however, that selection fellings can be made to pay, if the timber is converted, at stump site, into sizes which can be carried out. (It is understood that private merchants would give this work a trial.) Such a system is especially suitable for this type of country, for it is essential to consider the question of erosion. The rivers of Malabar appear to be getting ever more difficult for floating timber, owing to the silting up which follows heavy fellings in private forests of the hills. The Karumpuzha is the only river in the neighbourhood which still runs clear.

CHAPTER V.—WORKING PLAN FOR THE BAMBOO WORKING CIRCLE.

324. *Area.*—All the forests and plantations of the Nilambur Division are included in the Bamboo Working Circle.

325. *Departmental working.*—The bamboos (Bambusa arundinacea) required for rafting timber shall be cut departmentally in the areas from which extraction is cheapest. (This depends on the proximity of the supply of bamboos to floating rivers, and to the localities from which the timber is to be floated.) Unless absolutely unavoidable, departmental bamboo operations should not be undertaken in the forests leased from the Tirumalpad of Nilambur, since he charges stumpage at the rate of Rs. 3 to Rs. 4 per 100. Overworking of individual clumps has not been noticed to any appreciable extent in the past, and it should not be allowed in the future. None but hardened culms shall be cut. Only the tops of the culms are used for floating. and the usual method is to cut them above the thorny palisade. If it is found practicable, the thick ends of the bamboos should be used as cross-pieces for rafts, in order to prevent the hacking of poles and saplings in the understorey of the teak plantations. Finally, when bamboos are cut in the plantations, to relieve the teak from suppression, they shall be utilized for floating if it is economical to do so.

326. *Removal by purchasers.*—Except during times of general scarcity there is little demand from the public for bamboos from Government forests. Such demand as arises has been suitably met, in the past, by sales at seigniorage rates, and the same system shall be adopted in the future. In the very unlikely event of a large demand arising, the management can easily select suitable areas for working as bamboo coupes, and can lease them as is done in districts where the commercial exploitation of bamboo is practised.

327. *Control.*—The annual outturn of bamboos, from each locality exploited, will be recorded in the Control Book. The numbers of bamboos sold, and the revenue realized will also be entered. (Except in the case of bamboos sold standing, the year of extraction and year of sale will not necessarily be the same.) For examples of the entries to be made in the Control Book, see Appendix A.

CHAPTER VI.—WORKING PLAN FOR THE MINOR PRODUCE WORKING CIRCLE.

328. *Constitution of the working circle.*—The Minor Produce Working Circle covers the whole area to which this working plan applies.

329. *General lease of minor produce.*—The right to collect the following commodities shall be leased annually, by ranges :—Fruits of all kinds, seekai, roots, honey, wax, ginger, dammer and turmeric. Other items of minor produce may be included in the leases, if a demand arises, but horns and skins shall not be leased. The right to collect minor produce should be sold in public auction.

330. *Lease of canes.*—The right to collect canes, from the forests of the New Amarampalam Reserve, shall be leased at suitable intervals. It is probable that collection in alternate years will not exhaust the supply. It is therefore prescribed that the right shall be leased in alternate years, in the first instance. In the event of any serious decrease of the canes, leases shall be given every third year. The right has been leased for the year 1928–29. The period between 1st November and 31st May is the most suitable for collection. The next lease should therefore commence on 1st November 1930. The biggest traders, in this line of business, live in Tellicherry, Mahé, Cannanore, and other places on the coast. Despite the distance, it is believed that better prices will be obtained in public auction than by sealed tenders, especially if the auctions are held in Beypore or Calicut, both of which are within the jurisdiction of the District Forest Officer. It is therefore prescribed that the right to collect canes shall not be sold by tender unless auction sales are unsatisfactory.

331. *Control.*—The figures of outturn of minor produce, as supplied by the contractors, shall be recorded in the Control Book, together with the periods of the leases, and the revenue realized. See sample entries in Appendix A.

CHAPTER VII.—MISCELLANEOUS REGULATIONS (PRESCRIBED AND SUGGESTED).

SECTION 1.—ROADS AND OTHER EXPORT WORKS.

332. *Bridges.*—The prescriptions for the Conversion Working Circle are dependent on the construction of two bridges, in the near future. The possibility from natural forest timber alone, in that part of the Conversion Working Circle which lies in the Amarampalam range, is estimated to average 130,000 cubic feet per annum, at the very least, during the next 60 years. The Karumphuzha valley is the main export route for this timber, and the floating possibility of the river is said to be 60,000 cubic feet in addition to the thinnings of the Plantation Working Circle. Even if as much as 80,000 cubic feet of natural forest timber can be floated, Government is still losing the revenue on 50,000 cubic feet a year, except in the few years when the Punnapuzha can also be used for export. Taking the average possible profit on this timber, were the bridges in existence, at the very low figure of four annas a cubic foot, the annual loss at present is Rs. 12,500. Further, when pole crops of the Conversion Working Circle become due for thinning, the loss, without the bridges, will be enormous, for the poles cannot be extracted. Again, large quantities of timber of the less valuable species are burnt in clearings every year, for lack of export facilities. In the forests above the Conversion Working Circle, no development is possible until these bridges are erected. The above is the case from the point of view of exploitation, but the bridges will confer other benefits of equal importance, which cannot easily be expressed in the terms of rupees. The labour difficulty will be eased, and inspection of works, both by the District Forest Officer and his subordinates will be greatly facilitated, especially in the monsoon. Two bridge sites have been selected by the Chief Forest Engineer, with whom the whole question has been discussed. It is therefore expected that the Cherupuzha will be bridged at the place chosen (i.e., about a mile below its confluence with the Cheranganthodu) and that the Karumpuzha will be bridged at Nedungayam. These two bridges are roughly estimated to cost Rs. 20,000 and Rs. 70,000 respectively. Four minor bridges are required, and shall be constructed, on the Palat-Nellikutta road. Suitable bridges can be made for about Rs. 400 each, or about Rs. 1,200 for the four. All existing bridges shall be kept in good repair.

333. *Roads.*—A new road will be required in connexion with the two big bridges prescribed above. It will leave the present Nilambur-Nedungayam road near Karulai, and will pass through private land to the Cherupuzha bridge, and thence through Government teak plantations to Nedungayam. Its cost, including acquisition of land, is roughly estimated at Rs. 20,000. The metalling of the Palat-Nellikutta road shall be undertaken if it is found necessary. For the present, however, it is considered that improvements costing about Rs. 400 will be sufficient. It will, therefore, be made fit for fair-weather traffic in the very near future. No other permanent road construction is contemplated at present. All existing roads shall be kept in repair. Cart-tracks and bridle paths in common use shall be kept clear, and repaired as required. Other cart tracks shall be repaired when they are to be used for extraction of timber, and temporary cart-tracks shall be made wherever possible, in the felling areas, in order to reduce the dragging leads.

334. *Rafting facilities.*—At Nedungayam the number of places in the river in which rafts can be tied is limited. The management should consider the question of tying rafts on slip-ways on the bank, if it is found that sufficient rafts cannot be ready, in the river, for despatch as soon as floating conditions are favourable.

SECTION 2.—IMPROVEMENT OF METHODS OF EXPLOITATION.

335. *Exploitable species.*—The existing costs of Government extraction, from stump-site to the coast, are so high that only the most valuable species can now be extracted from clearings in natural forests. Floating is the item whose cost is most out of proportion. An endeavour must be made to exploit all or most of the species which are felled in clearings. To do this, it will probably be necessary either to sell the inferior species on the river-bank, or in other depots outside the coupes, or else to sell the coupes, standing, to contractors. The early shifting of the scene of

regeneration to Nellikutta, is made partly with the object of facilitating the exploitation of all species. By the time clear-fellings return to the New Amarampalam Reserve, the new road and bridges will enable the management to continue the profitable disposal of "junglewoods".

336. *Felling.*—Economy in felling is of great importance. Felling by axe is wasteful, but when big logs have to be dragged by elephants, the butt ends must be rounded to some extent, in order to ride easily over obstructions. In such cases, felling should be done by axe. Where tractors or skidders are to be used, felling should be done by saw, as soon as the felling coolies can be made proficient. Trees must, of course, be cut as Close to ground level as possible.

337. *Logging.*—In the Nilambur district, many of the trees are extracted whole, cutting off only the top. But where trees have to be sub-divided, there can be a lot of wastage through unintelligent or careless logging. The management must see that the most is made of each tree felled, by converting it into straight sound logs (when it has to be divided) and by making suitable logs out of the branchwood wherever possible.

338. *Extraction.*—A tractor has just been purchased and is on its way to Nilambur, at the time of writing. It will be used in accordance with the advice of the Engineering branch, and it should prove invaluable in relieving the elephants, and in getting "junglewoods" out cheaply, from clear-felled areas. Elephant power must be utilized to the best advantage, giving to each dragging elephant, loads suitable to its dragging capacity. Young elephants should be trained to drag poles. It is customary, at present, for the elephants to start work about 10 a.m. This is an absurdly late hour. They must be got out early, and must be rested in the middle of the day, at any rate in all except the coolest weather. Buffaloes shall be used to drag as much of the thinnings and other smaller produce as are within their capacity, so as to set elephants free for big timber. Buffaloes will also drag bamboos for floating, and shall be used for carting timber, etc., in the Government carts. In order to reduce dragging leads, carts must be used wherever possible. Further purchase of Government carts is not recommended, unless it is impossible to establish a regular system of contract carting. As soon as the new bridges are made, there should be little difficulty in organizing a regular supply of private carts, at low rates. (The present carting rates are excessive and must be reduced.) As regards floating in the Nilambur Range, unless the rates at present paid to the contractor can be materially reduced, it will be necessary to revert to departmental floating.

339. *Costs of exploitation.*—The excessive costs of many of the items of timber extraction have been discussed in Part I. They must be reduced. Attention is drawn to Mr. Bourne's costs of exploitation quoted in paragraph 122 of Part I.

340. *Timber forms.*—The timber forms, introduced with the commercial system of accounting, are much more suitable than the old timber forms, and their use should be continued. See paragraph 118 of Part I. The preparation of enumeration registers, prior to felling, has been prescribed in the working plans for working circles.

Section 3—Utilization of the Produce.

341. *Marketing.*—At present, practically all the timber goes down to the coast, where it is sold by the Forest Utilization Officer. This relieves the District Forest Officer of a considerable amount of work, but his responsibility must not be considered to end, when the timber reaches Beypore. He must work in close co-operation with the Forest Utilization Officer, and should keep in intimate touch with the coastal market, by attending as many of the auction sales as possible, so as to co-ordinate supply with demand. The establishment of connexion with new markets, both home and foreign, is within the province of the Forest Utilization Officer. A recent report by Mr. C. S. Martin, Chief Forest Engineer shows that Nilambur timber has prospects of making good in a number of centres of demand outside India. The results of selling small quantities of selected timber in London show that the export of good rosewood and of "figured" timber of *Terminalia tomentosa* (and possibly of other species) is a question that should be kept in mind. Local sales either at the river

side or in forest depots, or of standing timber, must also be considered. (It is unlikely that "junglewoods" cane sold profitably in any sales other than local.) The writer is firmly convinced that a timber sale depot besides the Nilambur railway station will be a most profitable concern. The right to convert teak spokes and felloes, in the coupes should be leased out each year. Minor produce leases will, if possible, be sold in auction. Bamboos shall be sold at fixed rates for removal by purchasers.

342. *Sale depots.*—There is already a big sale depot in Beypore and a smaller one in Kallai. The latter is not used at present but will be retained in case it may be required in the future. A piece of land, adjoining the Nilambur railway terminus has been acquired. A sale depot should be opened here as soon as possible in consultation with the Forest Utilization Officer.

343. *Grading of timber.*—The existing classification of teak timber and poles needs no improvement. A suitable system of grading other timber should be worked out. In this connexion it may be remarked that there is reason to suppose that good poles of such species as *Terminalia tomentosa*, *Lagerstrœmia microcarpa*, etc., can be extracted profitably, whereas they are burnt in clearings at present. They should be tried on the market in the near future.

344. *Possible development of forest industries.*—With the establishment of railway connexion between Nilambur and the main centres of timber consumption the prospects for sawmills and allied industries in or near the forests are bright. The question of hand-sawing in the forests should be considered especially in the case of the conversion of the less valuable species into sleepers for preservative treatment by the railways.

Section 4—Protection of Timber.

345. *Inspections.*—The pressure of more important work in the past has limited the scope of ordinary inspections by the District Forest Officer and his subordinates. He should attempt to give more time to such inspections especially in the outlying blocks of the Nilambur Range and should see that more patrolling is done by the subordinates.

346. *Timber transit rules.*—The transit rules should be revised at once to provide for the check of all timber exported from Nilambur by rail. The existing tanah at Pandicad should be transferred to the Palghat district and the Checking Officer transferred to the new station at Nilambur.

Section 5—Buildings, Wells, etc.

347. *New buildings.*—The following statement gives the minimum building programme required to house the existing staff as distributed at present. The works are given in order of urgency.

Serial number and description.	Estimated cost.
	RS.
1. Bungalow for one gazetted officer at Nilambur	9,000
2. Quarters for Assistant Veterinary Inspector at Nilambur ...	4,500
3. Quarters for two clerks at Nilambur	2,400
4. Quarters for the Range peon at Karulai	700
Total ...	16,600

When regeneration work commences in Nellikutta at least two small serambis will be required, one for a Ranger to camp in and one as a residence for a subordinate. Two such serambis will cost about Rs. 1,000, i.e., Rs. 500 each. It will probably be desirable to build them closer to the main road than the existing officer's serambi. A depot office and quarters for a depot watcher will be required in the new sale depot at Nilambur. The cost of these two buildings should be about Rs. 1,300. A tanah building near the railway station will also be necessary and will cost about Rs. 500.

The circuit house at Nilambur is often filled by touring Imperial Officers, and when they are accompanied by Provincial Service Officers, the latter usually find considerable difficulty in getting accommodation in Nilambur. Odd Rangers, too, often tour in the district. A two-roomed bungalow, with bath-rooms, should be built (possibly in the District Forest Office compound) for such occasional use. It would often be used as a residence by Extra Assistant Conservators, or Rangers, temporarily attached to the district, or on temporary jobs under other officers working in the district. The cost of such a building is estimated at Rs. 3,000.

348. *Repairs to existing buildings.*—All existing buildings shall be kept in repair. An exception is made in the case of the serambi at Karumpoya. It requires almost complete rebuilding, but is not needed at present. It will not be repaired for the present, but will be re-built, when and if it is required, in the future. The annual cost of repairs to buildings is estimated at Rs. 2,200 or Rs. 22,000 during the working plan period.

349. *Improvements in existing buildings.*—The following improvements are required :—

(i) New wooden record racks of improved pattern in the District Forest Office using up old wood estimated to cost Rs. 400.

(ii) Tiling the roof and providing a concret floor for the cordage shed at Nilambur at present used as a provision store. Estimate cost Rs. 300.

(This building is infested with rats and its thatched roof makes it susceptible to fire.)

350. *Coolie lines.*—It will certainly be necessary to import some of the labour to be employed in the Amarampalam Range in the future. In the first instance an attempt must be made to get these coolies to live near the work and temporary sheds to house at least 100 coolies should be made in Nellikutta before work commences there provided of course that arrangements have been made to get so many coolies. The cost of such sheds and repairs for five years will be about Rs. 700. If temporary sheds can be used a further sum of Rs. 500 will have to be spent when the scene of regeneration returns to the New Amarampalem Reserve. If coolies cannot be induced to live on the spot they must be carried to the work in motor lorries. In this event permanent cooly lines sufficient to house at least 50 coolies in the first instance should be constructed near Nilambur and a suitable site would be the hill-top beside the Karumpuzha village which is within the Pannengode block. Such permanent lines are estimated to cost Rs. 5,000 for construction and Rs. 250 a year for maintenance for seven years or Rs. 6,750 during the working plan period.

351. *Temporary sheds for various purposes.*—Temporary sheds for various purposes are always required—in elephant camps in regeneration areas for the use of bidders at elephant sales, etc. Rs. 5,000 is provided for expenditure during the working plan period.

352. *Wells.*—All wells which are in use shall be repaired periodically as required. The cost of recurring repairs is estimated at Rs. 1,000 during the next decade.

The well in the Range office compound at Karulai appears liable to fall in. If this happens a new well should be sunk near the Range office at a cost of about Rs. 1,200.

To prevent villagers using the well which supplies the District Forest Officer's bungalow and the circuit house, the site should be bought from the Nilambur Tirumalpad, who should be asked to repair the village well at the foot of the District Forest Officer's avenue. The District Forest Officer's well should be roofed. Purchase of the site and roofing the well should cost about Rs. 200.

353. *Rain gauge.*—A rain gauge is required at Nedungayam. It should be installed on a platform close to the rest-house. The cost is estimated at Rs. 40.

SECTION 6—MAINTENANCE OF BOUNDARIES.

354. *Permanent demarcation.*—When the re-survey, by the Madras Revenue Survey Party, is complete and correct, the permanent demarcation of all artificial boundaries of reserves and blocks shall be completed. Pillars of laterite in chunam

should be erected beside the new survey stones, at all bends. (This is not required in the Nilgiri-Malabar district boundary, in the New Amarampalam reserve.). Such enclosures as are not already demarcated correctly, shall be marked in the same way. Boundary pillars shall be repaired as required. The total cost in the next decade should not exceed Rs. 3,000.

355. *Register of boundaries.*—On receipt of the corrected re-survey data, a register of boundaries shall be compiled. In it shall be recorded the correct descriptions, with angles and field measurements, of all exterior boundaries and boundaries of enclosures.

SECTION 7—LIVE-STOCK.

356. *Working elephants.*—There are, at present, 27 working elephants in the Nilambur division. A tractor is to be employed in future, for some of the extraction, but, on the other hand, the annual outturn is to be greatly increased. Further, there is the possibility of reversion to departmental floating in the Nilambur range. Provision is therefore made for the permanent retention of 25 working elephants. If more are required, they should be kept. All elephants should, if possible, be rested for two months in the hot weather, and should be kept in camps where fodder and water are plentiful and good.

357. *Elephant capturing.*—Apart from providing elephants for forest work, elephant capturing operations can be productive of considerable revenue. The present sale prices obtainable for elephants are very good. Capturing operations should therefore be extended. The pit-fall method will be continued. The Kariem and Muriam forests are a sanctuary for elephants in the hot weather, when all the surrounding private forests are on fire. It is recommended that capturing operations be extended to that part of the Muriam block which is leased from the devaswam. A kraal will have to be erected, either in Muriam, or, if water is insufficient, in the Erambadam block, a few miles away. Since the Zamorin has now relinquished his claim to part value of elephants captured in Nellikutta, the objection to elephant-capturing in that block no longer exists, and it should be found a promising scene of operations. In the Karumpoya and New Amarampalam reserves, some of the new pits should be in new country. (It is believed that there is some tendency to keep to the same localities, year after year.) A sum of Rs. 10,750, to include the cost of a three-roomed kraal, is provided for elephant-capturing during the next decade.

358. *Buffaloes.*—There are, at present, 12½ pairs of buffaloes in the division. They are largely used for dragging teak poles and bamboos. Their use should be extended, and provision is made for the maintenance of 40 pairs. They should not be kept for too long a period, but may be sold, and new animals purchased.

359. *Bullocks.*—If a better method of soil æration than ploughing cannot be worked out, it will be necessary to plough some 60 acres of the Plantation Working Circle at the end of the monsoon, each year. Plough cattle are difficult to hire at this season, and the advisability of buying a few pairs of bullocks, before the monsoon, should be considered. They could either be sold on the completion of the work, or kept permanently for carting.

360. *Cost of feed and keep.*—The present costs of feed and keep of elephants and buffaloes are excessive, and reduction must be commenced at once, without, of course, reducing the scale or the quality of the rations. From the meagre records which are available for the period prior to the Malabar rebellion, it would appear that the cost of feed and keep has been almost doubled since 1919–20.

SECTION 8—STORES, TOOLS AND PLANT.

361. *Ordinary expenditure on stores and tools.*—Charges have to be incurred annually for the purchase and repair of boats, elephant harness and chains, carts, furniture, tools for use in regeneration work, etc. Provision is made for an annual expenditure of Rs. 7,500.

362. *Extraordinary expenditure.*— It is extremely probable that at least one motor lorry will be required for taking coolies to work. It will also be used for delivering sleepers at the railway. Rupees 4,000 is provided for the purchase of a lorry.

Running expenses may be debited against the funds provided for regeneration and exploitation. More lorries should be purchased, if required. (Funds for unforeseen expenditure are provided in the financial forecast.)

SECTION 9—CONTROL.

363. *General.*—Emphasis has already been laid on the importance of careful and efficient control of the execution of the working plan. Most of the control forms have already been mentioned in the working plans for the Plantation and Conversion Working Circles. The following records will be maintained :—Control Book, Record of Works, Compartment History, Control Journal Regneration Ledger, Register of Deviations from the Working Plan, and Control and Fire Maps. All shall be maintained in the District Forest office. By the 15th May of each year, copies of all entries, relating to the previous year, shall be made from the Control Book, Record of Works and Compartment History, and shall be submitted to the Conservator of the circle. The latter will send them for scrutiny to the Working Plans Conservator, who will post duplicate forms maintained in his office. Samples of the control forms will be found in Appendix A.

364. *Control Book.*—A single Control Book shall be maintained for the whole area covered by this working plan. It shall be divided into five parts. The first four parts will deal with the four working circles separately, and the annual entries shall be recorded as prescribed already. The fifth part will be an annual summary of revenue and expenditure, under the various headings which appear in Appendix A.

365. *Record of Works.*—A single Record of Works shall be maintained. It shall be divided into four parts. The first part will deal with the Plantation Working Circle, and the second with the Conversion Working Circle. Though no work is prescribed in the Inacessible Working Circle, it is possible that some work, such as making bridle-paths, may be undertaken. Pages of the Record of Works must therefore be set aside for the Inacessible Working Circle also. The last part of the Record of Works will control the execution of all works which cannot be allotted to a particular working circle.

366. *Compartment History.*—The posting of the compartment histories has been prescribed in the working plans for the Plantation and Conversion Working Circles. One set shall be maintained in the offices of each of the following officers :—District Forest Officer, Nilambur Range Officer, Amarampalam Range Officer, Conservator, Sixth Circle, and Conservator, Working Plans Circle. The District Forest Officer is responsible for posting the annual entries, and he shall send copies to the other officers named above, to enable them to maintain their sets of compartment histories

367. *Control Journal.*—A Control Journal, as prescribed in the Madras Forest Code, shall be maintained for the whole area covered by this working plan. The District Forest Note Book will be discontinued, but selected extracts should be copied into the Control Journal. Similarly, selections from Mr. Bourne's silvicultural notes should be recorded, under the different species, in the Control Journal now prescribed. It is essential to record the costs of exploitation in the Control Journal, for they cannot be closely watched in any of the other control forms. For the record of information in the journal, the following main headings (amongst others) are suggested :—natural reproduction ; bamboo flowering ; notes on the silviculture of important species ; injuries to the growing-stock ; notes on results of the various methods of artificial regeneration attempted ; notes on underwoods (natural and artificial) in plantations ; labour supply ; notes on exploitation, with costs.

368. *Regeneration Ledger.*—The maintenance of this ledger is prescribed in the Sixth Circle in Conservator's No. 2222 of 1924, dated 3rd November 1924. Its maintenance will be continued.

369. *Register of deviations.*—A register of deviations from the working plan shall be maintained. It should be divided into three parts :—" Plantation Working Circle ", " Conversion Working Circle ", and " Miscellaneous. " All that is required is a very brief account of the nature of each deviation, reasons for deviation, and number and date of the order conveying sanction.

370. *Maps.*—The maps to be maintained have been described in the working plans for the working circles.

CHAPTER VIII.—ESTABLISHMENT AND LABOUR.

SECTION 1—ESTABLISHMENT.

371. *Executive staff.*—The suitability of the existing executive staff for the revised programme of work will be tested in actual practice. If any increase of staff is found to be necessary, the District Forest Officer will submit suitable proposals. It is unlikely that any important changes will be required as regards the existing establishment of non-gazetted officers and subordinates. But it seems quite possible that the District Forest Officer will require a second gazetted assistant. Frequent changes of officers and rangers should be avoided.

372. *Distribution of the executive staff.*—The distribution of his staff is left largely to the discretion of the District Forest Officer. The tanadar at Pandicad should be transferred to Nilambur without delay, to hold charge of the new checking-station to be established near the railway terminus. The necessity of altering the constitution of the ranges may possibly arise in the near future. If most of the labour for working the Nellikutta Reserve has to be taken from and to Nilambur, the District Forest Officer should consider the advisability of transferring this Reserve, temporarily or permanently, to the Nilambur range, and should submit proposals, if necessary. It is essential for each Range Officer to bear the entire responsibility for the due execution of all works in his range. He should therefore be allowed to employ his assistant rangers as he thinks fit. The recognition of quasi-specialists, such as "Regeneration Rangers," is most undesirable.

373. *Clerical staff.*—If the commercial system of accounting is discontinued, the posts of Commercial Accountant and of Commercial Accounts Assistant should be abolished. Otherwise no change in the existing clerical staff is desirable. The District Forest Officer should take up the question of getting permanent sanction for more of the clerical posts, as it is unsatisfactory to have so many temporary clerks in posts which are never likely to be abolished.

SECTION 2—LABOUR.

374. *General.*—The labour shortage is acute. The present labour supply is not nearly sufficient for the work proposed in this working plan, and has not been really adequate for the proper execution of the less extensive works of recent years. A determined effort must be made at once to solve the problem. The manner of doing so is left to the District Forest Officer, but the writer would like to make suggestions, some of which may prove helpful. At the outset it must be explained that felling coolies are always available, and that there is no great difficulty in mustering large numbers of coolies for regeneration work between the middle of May and the middle of July. It is in the months of August to December, and March to the middle of May that local coolies are most difficult to obtain, and these are the seasons when a large labour force is required for weeding and for clearing and preparing regeneration areas.

375. *Nilambur range.*—On the basis of one coolie for each acre to be regenerated, it is estimated that at least 120 coolies will be required in the Nilambur Range from about the middle of February till about the end of December in each year. If larger numbers of women and children are employed, it should be possible to raise a local labour force of this size without importing additional coolies. If this is possible, it would certainly be preferable to incurring the expense of building quarters for labour recruited elsewhere. It may be necessary to raise the wage for ordinary men coolies to seven annas, and nobody could grudge this increase if good work were turned out. The payment of coolies, partly in cash and partly in kind, is a suggestion which may be worth considering. It would involve considerable trouble, but there is no doubt that the department could buy rice in bulk at much lower rates than the coolies pay to the retailers. As a result, the coolies would actually get higher wages, though the department would incur no additional expenditure. If floating is done departmentally in the Nilambur range, many of the coolies employed in rafting can probably be retained for other works during the rest of the year. To sum up, the difficulty should first be tackled by endeavouring to raise sufficient local labour, and if this is found impossible, as many additional coolies as are required shall be imported and housed.

376. *Amarampalam range.*—The most satisfactory solution of the labour problem in the Amarampalam range lies in the settlement of imported labour on the

land available for cultivation. One hundred and twenty-five acres of swamp near Nedungayam have recently been disreserved and are to be leased for cultivation by the Revenue Department. If this venture is successful, it should be easy for the Forest department to induce settlers to the large areas of swamp in the Karumpoya and New Amarampalam Reserves, especially if free cultivation is permitted in the first instance. In the meantime, the existing local labour force must be increased, as far as possible, by the increased employment of women and children and, if necessary, by raising the coolie wage as mentioned when considering the Nilambur range. It is proposed to work the Nellikutta Reserve in the early years of the ensuing period, and it is expected that about 50 coolies can be obtained in that neighbourhood. The Karulai coolies at present employed in the Amarampalam range should be taken to Nellikutta for a week or ten days at a time, as has recently been done when working beyond Mundacadavu. As many Shola Naickens as possible should be mustered. Even so, it is unlikely that sufficient labour can be raised without recruiting coolies from more distant places. It is probable that at least 50 coolies will have to be imported, and the question of housing them is left to the management. If possible, they should be accommodated in temporary lines near their work. Otherwise they must be housed in permanent buildings near Nilambur (see paragraph 350), whence they must be taken to their work daily, or possibly they can be made to stay in the forest for about a week at a time. If the latter course is feasible, it may be well worth while to import a much larger labour force, house them permanently near Nilambur, and employ them in two batches alternately in the Nilambur and in the Amarampalam ranges. While working in the Nilambur range they would return to their homes daily, and in the Amarampalam range they could live in the forests for about a week, and then return for a spell of work in Nilambur.

CHAPTER IX.—FINANCIAL FORECAST AND COST OF THE WORKING PLAN.

377. *Financial forecast.*—The yields from plantations are based on Mr. Bourne's yield tables. As regards the intermediate yields, the estimates are almost certain to be too low since the density of stocking used in the calculations is that found at the time of describing compartments in 1927, and does not allow for the increase in density between 1927 and the years of thinning. For this reason the estimated volume of thinnings have not been entered in the tabular statement of thinnings. The estimates of revenue and expenditure on timber operations are based on departmental working, since this is the system prevailing at the time of writing. Some removal by purchasers is likely in the future, and this will reduce the expenditure. The surplus should, however, be at least as great if not greater than that forecasted. A general tendency to under-estimate revenue and to over-estimate expenditure (within reasonable limits) has been observed.

Estimate of revenue.

	RS.
Plantation Working Circle—	
Teak Felling Series.	
Final fellings—998,000 cubic feet at Rs. 2-6-0 per cubic foot ...	23,70,000
Intermediate yields—202,000 cubic feet at Re. 1 per cubic foot; 340,000 cubic feet at 10 annas per cubic foot; 41,000 cubic foot at 6 annas per cubic foot	4,29,000
Miscellaneous Felling Series.	
Final fellings—4,000 cubic foot at 12 annas per cubic foot ...	3,000
Intermediate yields	1,000
Conversion Working Circle—	
Final fellings—610,000 cubic feet at Re. 1 per cubic foot ...	6,10,000
Subsidiary and improvement fellings—887,000 cubic feet at Rs. 1-4-0 per cubic foot	11,09,000
Xylia sleeper fellings	3,67,000
Thinnings	22,500
Bamboo Working Circle—	
Bamboos used in rafts to Beypore	2,00,000
Bamboos sold standing	1,000
Total ...	51,12,500

	RS.
Minor Produce Working Circle—	
Leases of minor produce	14,000
Leases of canes	8,000
General—	
Sale of elephants and cattle	50,000
Sale of fuel (karias)	2,500
Miscellaneous sales	27,000
Grand Total, Revenue ...	52,14,000

Estimate of Expenditure

Plantation Working Circle—	
Teak Felling Series.	
Extraction of final fellings—998,000 cubic feet at 3 annas per cubic foot	1,87,000
Extraction of intermediate yields—583,000 cubic feet at 5½ annas per cubic foot	2,00,000
Formation	38,000
Subsidiary tending	15,000
Expenditure on underwoods	5,000
Reclamation of failed areas for teak	2,800
Miscellaneous Felling Series.	
Extraction of final fellings—4,000 cubic feet at 4 annas per cubic foot	1,000
Thinning and cleaning, including extraction of intermediate yields	5,000
Artificial regeneration	5,000
Expenditure common to both Felling Series.	
Fire protection	16,000
Repairs to compartment boards	300
Conversion Working Circle—	
Extraction of final fellings—610,000 cubic feet at 7 annas per cubic foot	2,67,000
Extraction of subsidiary and improvement fellings—887,000 cubic feet at 8 annas per cubic foot	4,43,000
Extraction of Xylia sleeper fellings	1,84,000
Extraction of thinnings	19,000
Formation	1,00,000
Subsidiary tending in Periodic Block I	5,000
Subsidiary tending in the rest of the forest	7,000
Fire protection	30,000
Marking and maintenance of compartments	1,000
Bamboo Working Circle—	
Supply of bamboos for floating	2,00,000
General—	
Collection of seed for other districts	500
Purchase and maintenance of buffaloes	1,40,000
Elephant capturing	11,000
Feed and keep of elephants at Rs. 100 per month each	3,00,000
Stores, tools ond plant—ordinary	75,000
Plant—Extraordinary	4,000
Roads (Capital Rs. 20,000, Ordinary Rs. 29,000)	49,000
Bridges (Capital Rs. 91,200, Ordinary Rs. 800)	92,000
Buildings (Capital Rs. 28,800, Ordinary Rs. 28,200)	57,000
Temporary sheds	5,000
Wells	2,500
Rain gauge	40
Demarcation	3,000
Pay and allowances	7,00,000
Contingencies	17,000
Miscellaneous (Kuttikanam, telephone, etc.)	32,860
Grand Total, Expenditure ...	32,20,000
Grand surplus, Revenue ...	19,94,000

378. *Cost of the Working Plan.*—The working plan has cost Rs. 34,231–1–9. The following are the details of expenditure :—

	RS.	A.	P.
Pay of Working Plans Officer	16,732	14	0
Pay of establishment	6,981	3	0
Travelling allowances	9,710	2	0
Compensatory allowances	361	14	0
Field work	651	0	0
Contingencies	613	10	9
Total ...	35,050	11	9
Deduct expenditure apportioned to the revision of the Beypore Working Plan	819	10	0
Balance = Cost of Nilambur Working Plan ...	34,231	1	9

SUMMARY OF PRESCRIPTIONS.

PLANTATION WORKING CIRCLE.

A.—Teak Felling Series.

	Number of paragraph in the working plan
1. *Choice of species.*—All areas suitable for teak to be restocked with that species. Prescriptions made for experimental regeneration of the poorest localities both by teak coppice and by leaving natural understory of Xylia xylocarpa to form the new crop	226
2. *Silvicultural system.*—High forest clear-felling with artificial regeneration, except in certain of the poorest areas mentioned above	227
3. *Rotation.*—Seventy years	228
4. *Regulation of the yield.*—Yield to be regulated by "reduced" area, i.e., the annual coupe is got by reducing the total area under teak to I quality and dividing the result by 70	229
5. *Marking for final felling.*—The procedure has been detailed and provision has been made for check by a gazetted officer	230
6. *Marking of compartment boundaries.*—Existing compartment lines to be marked with stakes before compartments are felled and cleared	231
7. *Final felling.*—Methods of executing the felling and of marking and recording the outturn have been prescribed. Spokes and felloes to be converted to the full extent of the demand	232
8. *Clearing the area.*—Timber to be removed expeditiously. No stacking within the coupes or in young plantations. Early clear-felling of unsaleable material emphasised. Chips from conversion of spokes and felloes to be scattered over the area. First burn at the end of February and not later than the middle of March. Heaping and reburning described	233
9. *Collection of seed.*—Only the best seed to be used. Sources of good seed suggested. Three Palghat paras of seed for every acre to be regenerated	234
10. *Nurseries.*—Nurseries to be dug to a depth of one foot only and cracks to be made in the lower layers of soil to ensure drainage. Beds to be raised above ground level. Seed to be soaked in cold water for 48 hours before sowing. Sowing in two instalments (and possibly three) commencing about 24th April. Seeds to be covered lightly with soil and beds covered with twigs and straw until germination commences	235
11. *Aligning and staking.*—Espacement 6 feet × 6 feet. Lines to be laid out accurately. Bamboo stakes to be used ...	236
12. *Loosening soil at stakes.*—Soil to be loosened to a depth of one foot with pickaxes. Close supervision required	237

SUMMARY OF PRESCRIPTIONS—*cont.*

PLANTATION WORKING CIRCLE—*cont.*

A.—Teak Felling Series—cont.

	Number of paragraph in the working plan
13. *Formation.*—Complete stocking in the first year (and early in the monsoon) essential. Planting the main method of formation. Sowing on an experimental scale to see whether regeneration can be given an earlier start than is possible by planting. Methods and times of planting, sowing and replacement of casualties prescribed. Regeneration by teak coppice and by retaining an understory of Xylia xylocarpa in certain small areas of the poorest growth. Terminalia tomentosa to be raised in areas which turn swampy	238
14. *Weeding in the year of formation.*—First weeding in July, before the weeds flower, to be done by scraping the soil on strips 4 feet wide. Second weeding at the end of the monsoon to include soil aeration over the whole area. Third weeding probably unnecessary. Adventitious growth of tree species to be preserved in the course of weeding	239
15. *Artificial introduction of a ground cover crop.*—A ground cover crop to be introduced in order to keep down weeds. Probable time of introduction after the weeding of the second year	240
16. *Pruning.*—All forked stems and stout side branches to be pruned in April or May of the second year	241
17. *Second year weeding.*—Weeding, accompanied by thorough soil working in April or May of the second year, i.e., at the commencement of the growing season	242
18. *Exclusion of cattle.*—Cattle to be kept out of young plantation	243
19. *Thinning.*—Thinning aims at attaining the maximum volume increment per acre, consistent with maximum quality increment of individual stems. Even espacement of dominant trees essential. Hints for marking officers are given	244
20. *Climber cutting, Loranthus clearing, bamboo cutting and harvesting dead trees.*—These operations to be conducted at the time of thinning and at other intervals as required.	245
21. *Underwoods.*—Natural growth of tree species to be encouraged—by tending where necessary. Fast growing underwoods to be artificially introduced in a few grassy areas in old plantations. Hopea parviflora to be raised in suitable centres throughout the plantations to provide for the future	246
22. *Reclamation of second rotation failed areas in good teak localities.*—Good localities where second rotation teak has failed to be reclaimed for teak by methods prescribed ...	247

B.—Miscellaneous Felling Series.

23. *Choice of species.*—Natural pole crops of valuable species in failed plantations to be retained and tended. Artificial regeneration prescribed in a few areas where good natural tree crops are absent. Hopea parviflora in suitable areas to provide future underwoods in adjacent teak plantations.	255
24. *Silvicultural system.*—Natural regeneration under a shelter-wood the probable system of the future	256
25. *Rotation.*—Cannot be fixed at present	257
26. *Regulation of the yield.*—Yield to be regulated by area ...	258
27. *Fellings.*—Fellings to be executed with the least possible damage to the standing crop	259
28. *Artificial regeneration.*—Artifical regeneration with Terminalia tomentosa, rosewood and Artocarpus integrifolia prescribed in a few suitable areas where good tree crops are absent. Hopea parviflora to be raised under suitable shade in many of the sub-compartments of this felling series. Methods of regeneration have been described ...	260

SUMMARY OF PRESCRIPTIONS—*cont.*

PLANTATION WORKING CIRCLE—*cont.*

B.—Miscellaneous Felling Series—cont.

	Number of paragraph in the working plan
29. *Thinning and cleaning.*—Exact prescriptions for thinning and cleaning not formulated. These essentially silvicultural operations are left to the local officers. Suggestions have been made	261
C.—Prescriptions common to both Felling Series.	
30. *Fire protection.*—System of firelines, as marked on the maps, to be kept clear in the fire season and patrolled	266
31. *Protection against animals.*—Government elephants to be kept out of plantations (especially young woods) as far as possible. Stems damaged by animals to be coppiced, at least in the first two years after formation	267
32. *Protection against insects.*—In plantations two years old and under, stems damaged by borers to be cut back	268
33. *Choice of tools.*—The most suitable tools, for the various works, to be used	270
34. *Maintenance of compartment boards.*—The boards, bearing numbers, to be maintained at all corners of compartments, and repainted as required. Missing boards to be replaced.	271
35. *Control.*—Control Book, Record of works, Compartment History and control and fire maps to be maintained. Instructions for posting have been given	272 to 276
CONVERSION WORKING CIRCLE.	
1. *Conversion rotation.*—Sixty years	286
2. *Division into periods.*—Six periods of 10 years each	287
3. *Allotment to Periodic Blocks.*—Only the first Periodic Block has been selected, area 3,200 acres. Of this area, roughly 1,000 acres have been converted already. 2,200 acres to be converted by 1938, of which about 500 acres should be in the Nilambur Range and 1,700 acres in the Amarampalam Range. Separate prescriptions made for Periodic Block I and for the rest of the forest	288
A.—Periodic Block I.	
4. *Choice of species.*—Teak to be raised in the Amarampalam Range, with Hopea parviflora on hill-tops where soil is shallow. Various other species to be grown in the Nilambur Range; the choice is left largely to the District Forest Officer. Suggestions have been made	289
5. *Silvicultural systems.*—Clear-felling with artificial regeneration for forming teak woods. Other species to be raised both in the open and under shelterwoods, chiefly by artificial means	290
6. *Selection of areas for regeneration.*—The District Forest Officer must select the areas for regeneration. Suggestions have been made	291
7. *Regulation of the yield.*—Yield to be regulated by area ...	292
8. *Marking and felling.*—Methods of marking, felling and recording the outturn have been described	293
9. *Formation of teak plantations.*—A fierce burn is essential. Timely clearing of the area important. Espacement 6 ft. × 6 ft. "Ponam" regeneration to be employed if practicable, by method prescribed. Otherwise direct sowing probably the best method. Importance of using good seed, of full stocking in the first year, and of close supervision emphasized. Methods and times of weeding laid down	294
10. *Second year tending of teak plantations.*—Pruning and a single weeding in the second year will probably be all the tending required. Methods described	295
11. *Introduction of Hopea on hill-tops adjoining teak plantations.*—On hill-tops where the soil is too shallow for teak, Hopea parviflora is to be introduced at an espacement of 9 ft. × 9 ft., wherever shade is suitable. Casualties to be replaced in the second and third years	296

SUMMARY OF PRESCRIPTIONS—*cont.*

CONVERSION WORKING CIRCLE—*cont.*

A.—Periodic Block I—cont.

	Number of paragraph in the working plan
12. *Formation of crops of miscellaneous species.*—Miscellaneous species to be raised in the Nilambur Range. The cheapest and most efficient methods to be evolved. "Ponam" regeneration to be attempted. Methods left largely to the District Forest Officer. Suggestions made	297
13. *Tending subsequent to the establishment of the crops.*—Bamboos to be cut, in teak plantations, as often as necessary. Climbers to be cut at the same time. Crops of other species to be tended according to their individual requirements. Stems damaged by animals or by borers to be coppiced, in the first two years after formation	298
14. *Thinning.*—Teak plantations to be thinned as prescribed for the Plantation Working Circle. Crops of other species, raised between 1916 and 1927, to be thinned if required, when thinning the teak. Necessity for thinning unlikely in crops of other species formed from 1928 onwards ...	299
B.—Conversion Working Circle exclusive of Periodic Block I.	
15. *General.*—In the rest of the forest, mature and overmature trees to be harvested, before they decay. The trees left standing to be tended so as to attain their best development prior to final felling. Wherever possible, conversion is to be effected, without artificial regeneration, by means of improvement felling and tending	300
16. *Period of working.*—Most of the forests to be worked, with the above objects, during a period of twenty years. The poorest forests to be worked over in ten years, for removal of mature Xylia xylocarpa	301
17. *Division into annual coupes.*—Twenty annual coupes for subsidiary and improvement fellings in the good natural forests, and ten annual coupes in the poorest forests, have been prescribed	302
18. *Subsidiary fellings.*—In the good forests all trees of the best species, above certain fixed girths, are to be felled, provided the soil is not exposed. Methods of marking, felling and recording the outturn have been prescribed	303
19. *Climber cutting after subsidiary fellings.*—Climbers to be cut on all trees of good species, after the subsidiary fellings ...	304
20. *Conversion by means of improvement fellings.*—Natural pole crops to be improved by removal of the overwood and softwoods of pole size, thinning the pole crops, and cutting climbers	305
21. *Xylia sleeper fellings.*—Xylia xylocarpa, of 5 feet breast-height girth and upwards, to be felled in the poor forests of the Nilambur Range, and converted into sleepers in the forest, unless extraction in the log is found more profitable	306
22. *Regulation of the yield.*—Yield to be regulated by area, subject to a volume check to keep the outturn within the extraction possibility	307
C.—Prescriptions common to the whole Working Circle.	
23. *Formation and maintenance of compartments.*—Existing compartment lines to be kept clear, and boards repainted and replaced as required. All new plantations, on formation, to be divided into compartments, marked and numbered. Areas above 10 acres in extent, which are converted by means of improvement fellings, to be similarly marked and numbered; areas of less than 10 acres to be marked in a cheaper manner, numbered and mapped	308
24. *Fire protection.*—Compartment boundaries to be cleared as firelines, and patrolled in the fire season. Existing natural forest firelines to be cleared and patrolled	309
25. *Control.*—Control records, similar to those prescribed for the Plantation Working Circle, to be maintained. Maps to be posted with the areas of the coupes worked each year.	316 to 320

SUMMARY OF PRESCRIPTIONS—*cont.*

INACCESSIBLE WORKING CIRCLE.

	Number of paragraph in the working plan
1. *Prescriptions.*—The Inaccessible Working Circle will not be worked under the provisions of this working plan. In the event of future working, stress is laid on the necessity of preventing erosion	323

BAMBOO WORKING CIRCLE.

1. *Departmental working.*—Bamboos, for floating, to be cut in localities from which extraction is cheapest. Only hardened culms to be cut. Clumps not to be overworked. The thick ends of the bamboos should be used as cross-pieces for rafts, if practicable	325
2. *Removal by purchasers.*—The demand is small. Permits to be issued as in the past	326
3. *Control.*—The working of bamboos to be recorded in the Control Book	327

MINOR PRODUCE WORKING CIRCLE.

1. *Leases.*—The right to collect general items of minor produce to be leased annually, for each range separately. The right to collect canes, from the New Amarampalam Reserve, to be leased in alternate years, unless there is a marked decrease in the supply of canes. Public auctions preferable to sealed tenders	329 and 330
2. *Control.*—The working of minor produce to be controlled in the Control Book	331

MISCELLANEOUS REGULATIONS.

1. *Bridges.*—To provide facilities for export from the New Amarampalam Reserve, the Cherupuzha and the Karumpuzha are to be bridged at a cost of Rs. 90,000. Four minor bridges required on the Nellicutta-Palat road. All existing bridges to be kept in repair	332
2. *Roads.*—A new road, costing about Rs. 20,000, to be constructed in connexion with the two big bridges proposed. Other road work to consist of repairs to existing roads, cart-tracks, etc., and making temporary cart-tracks in the coupes	333
3. *Rafting facilities* —Tying rafts, on slipways on the river bank at Nedungayam to be considered	334
4. *Exploitable species.*—All species in clear-felling areas to be exploited, if possible. Sales near the coupes, or sale of standing timber suggested, in order to make a profit on "junglewoods"	335
5. *Felling and logging.*—Felling and logging to be done in the most economical manner. Prescriptions and suggestions made	336 and 337
6. *Extraction.*—A tractor to be used, to relieve the elephants. Elephant power to be utilized to the best advantage. Use of buffaloes for dragging to be extended	338
7. *Costs of exploitation.*—Costs of exploitation to be reduced ...	339
8. *Timber forms.*—The timber forms at present used to be continued	340
9. *Marketing.*—The District Forest Officer to co-operate closely with the Forest Utilization Officer, and to attend sales at Beypore. Connexion with new markets to be established. Local sales suggested. Teak spokes and felloes to be converted in the coupes by purchasers. Minor produce to be leased. Bamboos to be sold on permit	341
10. *Sale depots.*—A new sale depot to be instituted at Nilambur, Beypore and Kallai depots to be kept	342
11. *Grading of timber.*—Suitable systems of grading timber other than teak, in sale depots, to be evolved	343
12. *Development of forest industries.*—Saw-milling enterprises to be encouraged. Hand-sawing of certain timbers, in the forest, suggested	344

293, For.—50

MISCELLANEOUS REGULATIONS—*cont.*

	Number of paragraph in the working plan
13. *Protection of timber.*—More frequent inspections of outlying blocks required. Timber transit rules to be amended, to allow for check of timber at Nilambur railway terminus. New checking station prescribed	345 and 346
14. *Buildings.*—New buildings prescribed. Existing buildings to be repaired. Improvements prescribed	347 to 349
15. *Cooly lines.*—Provision made for construction of quarters for imported labour	350
16. *Temporary sheds.*—Construction of temporary sheds provided for	351
17. *Wells.*—Repairs and improvements to wells prescribed. A new well to be sunk at Karulai, if one of the existing wells falls in	352
18. *Rain gauge.*—A rain gauge to be installed at Nedungayam.	353
19. *Maintenance of boundaries.*—Permanent demarcation to be completed, and a register of boundaries prepared ...	354 and 355
20. *Working elephants.*—Twenty-five working elephants to be kept permanently	356
21. *Elephant capturing.*—New localities to be tried, and capturing operations extended	357
22. *Buffaloes.*—Forty pairs of buffaloes provided for	358
23. *Bullocks.*—Bullocks to be bought, for ploughing, if necessary	359
24. *Cost of feed and keep.*—Costs to be reduced, without reducing either quality or quantity of rations	360
25. *Stores, tools and plant.*—Provision made for purchase of a motor lorry, and for annual expenditure on stores, tools and plant	361 and 362
26. *Control.*—Instructions for maintenance of the following control forms have been given :—Control book, Record of works, Compartment history, Control journal, Regeneration Ledger, Register of deviations and maps	363 to 370

ESTABLISHMENT AND LABOUR.

1. *Establishment.*—No increase of staff proposed until the suitability of the existing staff, for the revised programme of work, has been tested. Reduction of clerical staff may be possible	371 to 373
2. *Labour.*—Special measures for increasing the labour supply are required urgently. Suggestions have been made ...	374 to 376

Proceedings of the Chief Conservator of Forests

Proceedings No. 293, Press, 17th August 1928

Working Plan (revised)—Nilambur Valley Forests.

A. WIMBUSH, Esq., I.F.S.,
Acting Chief Conservator of Forests.

READ—the following paper :—

Letter from A. WIMBUSH, Esq., Conservator of Forests, III (Working Plans) Circle, to the Chief Conservator of Forests, Madras, dated Ootacamund, the 11th July 1928, No. A. 411/25.

[Revised Working Plan—Nilambur Valley by R. S. Browne, Esq., Deputy Conservator of Forests.]

I forward for sanction the revised Working Plan for the forests of Nilambur Valley prepared by Mr. R. S. Browne, Deputy Conservator of Forests.

2. The Working Plan has already been read and noted upon by you and the points raised have been discussed at a meeting between you, the Conservator of Forests, VI Circle, and me. The small additions and alterations decided upon as necessary at that meeting have been made.

3. Mr. Browne has worked in consultation with me throughout but, whereas in the case of several other Working Plans parts of the plan have been written by me, in the case of this Nilambur plan, the finished article is entirely the production of Mr. Browne, apart from the petty modifications referred to in paragraph 2 above. I think that the Working Plan reflects great credit upon Mr. Browne.

4. The following maps are sent separately :—

(i) Key map.

(ii) Map relating to compartments of Chatomborai, Pokode, and Pannengode.

(iii) Map relating to compartments of Karumpoya, Nellicutta and New Amarampalam.

(iv) Map relating to compartments of Edacode, Elanjeri, Ramalur, Arevakode and Aravallikava.

(v) Map relating to Old Amarampalam.

Only the key map is to be printed for inclusion in the pocket of Working Plan book.

5. Fair copies of the Compartment History, embodying some hundreds of sheets which will have to be printed and bound in several volumes, will be sent very shortly.

Proceedings—No. 293, Press, dated 17th August 1928.

Sanctioned.

A. WIMBUSH,
Acting Chief Conservator of Forests.

(True copy)

E. B. RAMACHANDRA RAO,
Personal Assistant.

To the Conservator, III (Working Plans) Circle.
,, Conservator of Forests, VI Circle.
District Forest Officer, Nilambur.

Copy to other Conservators of Forests and District Forest Officers.
,, the Forest College, Coimbatore.
,, the Chief Forest Engineer.
,, the Forest Research Officer.

[Appendices.

APPENDICES.

The following are the appendices to this working plan :—

(i) Appendix A, samples of control forms.

(ii) Appendix B, history and description of compartments in the Plantation and Conversion Working Circle.

(iii) Appendix C, maps. A general map, scale 1 inch = one mile, and a set of four stock maps of the Plantation Working Circle, scale 8 inches = one mile.

Appendix A is printed at the end of the working plan. A copy of the 1 inch = one mile map accompanies each copy of the plan. The stock maps, and the history and description of compartments are available only for the officers directly concerned with the execution and control of the working plan.

APPENDIX A.

SAMPLES OF CONTROL FORMS.

Control Book.

Plantation Working Circle.

Provisions of Working Plan.						Result of operations.										
Year of felling.	Locality to be exploited.				Nature of felling.	Year of felling.	Locality exploited.				Nature of felling.	Details of actual yield.			Total actual yield in cubic feet.	Yield estimated from yield tables.
	Name of block and year of plantation.	Compartment number.	Sub-compartment letter.	Total area in acres.			Name of block and year of plantation.	Compartment number.	Sub-compartment letters.	Total area in acres.		Species and classification.	Number of trees.	Volume in cubic feet.		
	Teak Felling Series.						Teak Felling Series.									
1930–31.	Pannengode, 1854.	119	*a*, *b*. ..	ACS. 8·5	Felling teak and leaving Xylia underwood in compartments 121 *d* and 122 *c*. Final clear-felling elsewhere.	1930–31.	Pannengode, 1854.	119	*a*, *b* ..	ACS. 8·5	Final clear-felling.	Teak— 6 to 8 candies.	6	950	..	
	Do.	121	*a*, *b*, *c*, *d*	13·2								4 to 6 ,,	12	1,507	..	
	Do.	122	*a*, *b*, *c*	18·9								2 to 4 ,, etc.	68	3,721	..	
	Karumpoya, 1908.	321	*d*, *e* ..	21·0								Terminalia tomentosa.	1	72	..	
							Do.	121	*a*, *b*, *c*, *d*, etc.	13·2	Sub-compartments *a*, *b*, *c* were clear-felled. Teak felled and Xylia left in *d*.	eak-- 4 to 6 candies, etc.	4	472	..	
	Miscellaneous Felling Series.						Miscellaneous Felling Series.									
	Pannengode, 1854.	122	*m* ..	1·3	Final felling of saleable material leaving good poles for shade, etc.		Pannengode, 1854.	122	*m* ..	1·3	A few good poles and saplings left. Other saleable material clear felled.	Terminalia tomentosa.	6	120		
												Bamboo tops ..	75	..	Timber 120 cubic feet, bamboos 75.	

Control Book.

Conversion Working Circle.

Provisions of Working Plan.				Result of operation.							
	Locality to be exploited.				Locality exploited.			Details of yield.			
Year of felling.	Description.	Area in acres.	Nature of felling.	Year of felling.	Description.	Area in acres.	Nature of felling.	Species and classification.	Number.	Volume in cubic feet.	Total volume of yield in cubic feet.
1928–29 ..	Nilambur Range. Amarampalam Range. } Periodic Block I.	50 130	Final felling, with possible retention of some shade trees.	1928–29 ..	Old Amarampalam (Periodic Block I).	28·4	Clear-felling of saleable timber. Unsaleable material left for shade.	Terminalia paniculata logs	48	1,747	
								Terminalia tomentosa logs	11	390	
								Rosewood logs	4	172	
								etc.		etc.	
											8,472
	....	..	....		Kanhirakadavu (Periodic Block I).	131·6	Forest left standing on 9·8 acres of hill-top, as shade for Hopea. Remainder clear-felled.	*Teak* 2 to 4 candies ..	12	385	
								Below 2 candies ..	8	157	
								Measurables	6	47	
								Terminalia paniculata logs	321	21 532	
								etc.		etc.	
											35,749
	Unworked area of— Coupe I. Coupe II.	} 520	Subsidiary and improvement fellings.		Unworked area of— Coupe I.	478	Subsidiary and improvement fellings.	Terminalia paniculata logs	259	21,728	
								Terminalia tomentosa logs	39	2,876	
								etc.		etc.	
										29,854	
	....	..	....		Coupe II	520	Do.	Terminalia paniculata logs	976	59,721	
								Terminalia tomentosa logs	97	6,248	
								etc.		etc.	
										82,120	
											111,974
	Coupe I-A .. .. Coupe I-B	78 90	Xylia sleeper fellings ..		Coupe I-A	78	257 marked Xylia trees felled and removed in the log. No sleepers converted as logs more profitable.	Xylia xylocarpa logs ..	317	5,271	
	....	..	....		Coupe I-B	90	308 marked Xylia trees felled and removed in the log. No sleepers converted as logs more profitable.	Do. ..	462	6,478	
											11,749

Central Book.

Bamboo Working Circle.

Year.	Bamboos felled for departmental floating.			Bamboos sold in Beypore depot.		Bamboos removed by purchasers.			
	Locality.	Number.	Cost.	Number.	Revenue.	Locality.	Number.	Rate per 120.	Revenue.
			RS. A. P.		RS. A. P.			RS.	RS. A. P.
1928–29	Pokode natural forests.	10,000	500 0 0	1,08,200	5,416 12 0	Chatomborai natural forests, etc.	240	4, etc.	8 0 0
	Edacode natural forests, etc.	15,000	850 0 0 etc						
	Total ..	120,000	7,200 0 0	108,200	5,416 12 0		3,000	..	100 0 0

Minor Produce Working Circle.

Year.	Description of lease.	Duration of lease.	Details of yield extracted.	Revenue realized.
				RS. A. P.
1928–29	Minor produce, Nilambur Range.	1st July 1928 to 30th June 1929.	Fruits	
			Seekai	
			Roots	
			Honey	
			Wax	
			Ginger	
			Turmeric	350 0 0
	Minor produce, Amarampalam Range.	Do.	Fruits, etc.	1,200 0 0
	Canes, Amarampalem Range ..	1st April 1928 to 31st March 1929.	Canes	1,565 0 0

Annual Summary of Revenue.

Year.	Revenue from :							Total revenue.
	Plantation teak.	Other timber.	Bamboos.	Fuel.	Minor produce.	Sale of elephants and cattle.	Miscellaneous.	
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1928–29, 1929–30, etc.	2,80,092 7 0	1,98,271 12 0	20,763 3 0	269 6 0	2,100 8 0	5,021 0 0	2,321 8 0	5,09,139 12 0

Annual Summary of Expenditure.

Year.	Cost of acquisition and lease payments.	Cost of Conservancy and Exploitation.				
		Regeneration, tending and maintenance.	Fire protection.	Exploitation.		
				Timber and poles.	Bamboos.	Live-stock.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1928–29	1,982 12 3	19,271 8 0	4,200 6 0	1,32,721 5 0	19,758 2 0	33,178 8 0

Year.	Cost of Works.			Cost of elephant capturing.	Miscellaneous.	Cost of Establishment.		Total expenditure.
	Roads, etc.	Buildings.	Other works.			Pay and allowances.	Contingencies.	
	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
1928–29	3,719 2 0	11,718 3 0	155 8 0	1,217 2 0	4,361 8 0	69,112 6 0	1,582 1 0	3,02,978 7 3

Record of Works.

Plantation Working Circle.

Provisions of Working Plan.					Result of operations.					
Year of working.	Nature of operation.	Name of block and year of plantation.	Compartment and sub-compartment.	Area in acres.	Year of working.	Name of block and year of plantation.	Compartment and sub-compartment.	Area in acres.	Nature of work done.	Cost.
										RS. A. P
					Teak Felling Series.					
1928-29.	Formation and first year tending.	Edacode, 1848 .. Do. 1851 .. Do. 1851, etc. ..	77 a, b .. .. 83 a, b, c .. .. 88 a, b, c	ACS. 17·8 24·5 21·3	1928-29.	Edacode, 1848 .. Do. 1851 .. Do. 1851 ..	77 a, b .. .. 83 a, b, c .. .. 88 a, b and part of c.	ACS. 17·8 24·5 17·3	Felling unsaleable material ..	(a) 20 6 0
									Burning	(a) 508 0 0
									Staking	140 0 0
									Loosening soil with picks ..	135 0 0
									Collection of seed	(a) 108 8 0
									Making and tending nursery ..	250 0 0
									Planting	71 12 0
									First weeding and replacing casualties	192 7 0
									Second weeding and ploughing.	504 11 0
						Do. 1851 ..	88 c (part)	4·0	Natural underwood of hopea parviflora left standing and cleaned	....
	Second year tending ..	Edacode, 1846 .. —— 1926, etc.	74 a	9·8		Edacode, 1846 .. —— 1926, etc. ..	74 a	9·8	Saplings broken in final fellings, cut back, etc.	7 4 0
									Clean weeded and soil dug with picks in mid-April	98 7 0
									Pruned in May	0 12 0
	Thinning	Edacode, 1893 ..	52 a, b, c .. .. 53 a, b, c .. .. 54 a, b, c .. .. 60 a, b, c	17·7 16·1 10·5 6·5		Edacode, 1893 ..	52 a, b, c	17·7	Marking for thinning	20 0 0
							53 a, b, c	16·1	Felling	207 11 0
							54 a, b, c	10·5	Cutting climbers and Loranthus.	25 8 0
							60 a, b, c	6·5	....	....
		Do. 1894 ..	45 a, b, c, d ..	14·5		Edacode, 1894 ..	45 a, b, c, d ..	14·5	Marking for thinning	22 8 0
						....	....	..	Felling	219 2 0
	Climber cutting, removing Loranthus, harvesting dead and top-broken trees, cutting bamboos, injuring teak.	Walluvasseri, 1864, 1865, 1866-A, etc.	51 a, b, etc. .. All compartments ..	7·8 206·8		Walluvasseri, 1864, 1865, 1866-A, etc.	51 a, b	7·8, etc.	Cutting climbers and Loranthus.	29 7 0
							All compartments, etc.	206·8	Cutting climbers and removing and burning Loranthus ..	35 12 0
									Felling top-broken and dead trees. Logging fallen trees. Classifying, etc. (27 trees) ..	7 14 0
					Miscellaneous Felling Series.					
1928-29.	Planting Hopea parviflora 9 ft. × 9 ft. under suitable shade.	Walluvasseri, 1888, etc.	148 m., 149 m. and 150 m., etc.	..	1928-29.	Walluvasseri, 1888 ..	148 m., 149 m., 150 m., etc.	9·8	Staking 9 ft. × 9 ft.	19 12 0
									One-year old nursery seedlings planted in small areas of suitable shade on 15th June ..	10 0 0
									Casualties replaced in July ..	1 8 0
									Proportion of seed collection and nurseries	(b) 32 0 0
					Common to whole Working Circle.					
1928-29.	Fire protection. Clearing all lines in Amarampalam Range and the north and south network in Nilambur Range, etc.	....	....	..	1928-29.	Amarampalam Range.	All fire-lines.	..	Clearing 15 miles 6 furlongs and pay of fire patrols ..	920 0 0
						Nilambur Range ..	North and south net-work, etc.		Clearing 29 miles 2 furlongs and pay of fire patrols	1,496 7 0

(a) The whole cost of felling and seed collection and Rs. 470 of the cost of burning were incurred in the financial year 1927–28.
(b) Cost of seed collection and nursery incurred in 1927–28.

Record of Works.

Miscellaneous.

Year.	Nature of works.	Brief details of work done.	Cost. RS.	A.	P.
1928-29	Repairs to buildings	District Forest Officer's bungalow—white-washing	200	4	0
		District Forest Office's bungalow—whitewashing	107	2	
		Range quarter's, Nilambur. Petty repairs to roof	18	11	0
	Repairs to roads	Nellicutta-Palat road—Clearing drains four miles one furlong—Rs. 80-12-0			
		Gravelling—Rs. 206-8-0			
		etc. etc.	368	10	0
	Elephant capturing	....			
	Repairs to boats	....			
	etc.	....			

Pannengode 1864.

Compartment 145.

Total in acres.	Unproductive area in acres.		Sub-Compartments.							Description of the overwood.	Underwood and undergrowth.
	River bank.	Roads and fire lines.	Sub-compartment letter.	Area in acres.	Aspect, slope, soil.	Age in years in March 1928.	Density of crop.	Quality of locality according to yield tables.	Volume of stem-wood according to yield tables. (V — Sm × h and s — $(\frac{g}{4})^2$ cubic feet.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
17·7	..	0·5	*a* (2 areas)	1·0	Aspect—South-east .. .. Slope—Gentle to moderate. Soil—Disintegrated gneiss and laterite alluvium.	64	·8	II	1,739	*a* and *b*.—Pure teak. Thinned too heavily in 1923-24. Much of the crop is poor. (The locality is doubtful for a second rotation of teak.) *c*.—Natural forest, unplanted. *m*.—Lagerstroemia Flos-Reginae close to the stream. Terminalia paniculata and Cleistanthus collinus elsewhere. Parts are open and grassy.	Underwood—Very scanty. A few saplings of Cleistanthus collinus and Macaranga Roxburghii. Undergrowth—The fire of 1926 was exceptionally fierce and left the ground absolutely bare. Mimosa pudica is now appearing in parts and there is a little regeneration and regrowth of Macaranga Roxburghii and Cleistanthus collinus.
			b	11·4	Aspect—Varying .. .. .. Slope—Moderate. Soil—Disintegrated laterite and laterite alluvium.	64	·7	III	11,364		
			c	3·8	Soil—Disintegrated laterite.	..	..	Unplanted.	....		
			m	1·0	Aspect—Varying and slight .. Slope—Gentle to level. Soil—Laterite alluvium with a little disintegrated laterite. Swampy.	64	..	Failure (Miscellaneous felling series).	....		

History to Date.

Year.	Details of History.
1864	Natural forest clear-felled and planted with teak $6\frac{1}{2}$ feet × $6\frac{1}{2}$ feet.
1864–1906	All undergrowth cleared annually or in alternate years.
1878–79	Thinned. No details of yield available.
1881–82	Do. Do.
1884–85	Do. Do.
1889–90	Do. Do.
1894–95	Do. Do.
1896–97	Do. Do.
1901–02	Do. Do.
1906–07	Do. Do.
1911–12	Do. Do.
1916–17	Do. Do.
1923–24	Do. Loranthus cleared. Actual yield .. 2,255 c. ft. Yield estimated from yield tables .. 596 c. ft. Details of yield.

			C. FT.
Teak.	Above 4 candies	1 of	70·00
,,	,, 2 ,, ...	5 of	166·19
,,	Below 2 ,, ...	76 of	1,013·28
,,	Short logs	19 of	124·27
,,	Measurables	72 of	478·91
,,	Superior small	26 of	122·20
,,	I Class	29 of	70·00
,,	II ,, ...	12 of	27·60
,,	III ,, ...	1 of	1·40
,,	VII ,, ...	76 of	83·60
,,	VIII ,, ...	28 of	86·80
Terminalia paniculata	.. ..	1 of	10·58
		346	2,254·83

Year.	Details of History.
1926 (March—April).	Compartment burnt by orders of Chief Conservator.
1926-27 (December—January).	Burning again attempted but fire did not spread.

New Amarampalam 1916. Compartment 345.

Total area in acres.	Aspect, slope, soil.	Age in years in March 1928.	Description of the overwood.	Underwood and undergrowth.
8·0	Aspect—Nil. Slope—Level. Soil—Disintegrated gneiss and river alluvium.	12	Pure teak. Density 1. Growth generally good Contains a permanent sample plot north of the road.	Underwood—Nil. Undergrowth—Scatterel. Calycopteris floribunda, lantana and creepers. Some hopea parviflora introduced artificially in a plot of 1 acre south of the road.

History to date.

Year.	Details of History.
1916	Natural forest clear-felled, burnt and planted with teak, 6½ feet × 6½ feet and weeded.
1917–18	Weeded.
1918–19	Do.
1920–21	Thinned mechanically. No details of yield available.
1927–28	Climbers cut.

NILAMBUR VALLEY
WORKING PLAN MAP

Reg No. 564
Copies 190

Prepared By
C. R. Samarapuri
Draftsman

R. S. BROWNE
WORKING PLAN OFFICER
NILAMBUR
4-4-28

A. Wimbush
4·7·28
CONSERVATOR OF FORESTS
WORKING PLAN (3RD) CIRCLE
OOTACAMUND

Helio-Zinco., Survey Office, Madras.
1929.